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ABSTRACT

Presented is an overview of the national investment in research and development (R&D) in terms of expenditures and the utilization of R&D scientists and engineers. Four sectors of the economy are included: government, industry, universities and colleges, and other non-profit institutions. The data presented are based primarily on a series of surveys conducted by the National Science Foundation (NSF) between 1953 and 1977. Highlights of the report include the estimate that total R&D spending will reach $40.8 billion in 1977 and account for 2.2% of the gross national product. About 53% of this support comes from the Federal Government. Approximately 542,000 R&D scientists and engineers were employed in 1976. The report includes descriptions of R&D funding patterns and examines work in three areas: basic research, applied research, and development. The funding and manpower patterns in each sector of the economy are analyzed. Appendices provide statistical tables and technical notes. (SD)

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NATIONAL PATTERNS OF R&D RESOURCES

Funds & Manpower in the United States 1953-1977

National Science Foundation—NSF 77-310

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FOREWORD

The economic health of the Nation, as measured in terms of such indicators as real growth in GNP and levels of employment, is showing definite signs of regaining its viability after a somewhat erratic and sluggish period. Sustained economic expansion, one capable of absorbing a growing labor force, depends in part on scientific and technological breakthroughs which provide opportunities for business investment, increase productivity of capital and labor, and create a competitive edge for the United States in the world economy.

Evidence of the vital role of science and technology is given by the allocation of resources to research and development and to the training and utilization of scientists and engineers. Furthermore, each sector of the economy, government, industry, universities and colleges, and other nonprofit institutions, plays an essential role in the establishment and maintenance of a strong R&D capability. This report presents an overview of the Nation's investment in research and development in terms of expenditures and the utilization of R&D scientists and engineers.

The data contained in this publication are based primarily on a series of National Science Foundation surveys on R&D resources in the United States. The surveys are generally conducted on an annual or biennial basis. This report summarizes the allocation of R&D funding and manpower among the four major sectors of the economy. Funding data include total research and development, basic research, applied research, and development for the period 1953-77. Time series on science and engineering manpower engaged in R&D activities are presented for each sector for 1953-76.

The report was prepared in NSF's Directorate of Scientific, Technological and International Affairs, Division of Science Resources Studies, under the general guidance of Charles E. Falk, Director, and William L. Stewart, Head, R&D Economic Studies Section. The National Science Foundation would appreciate receiving substantive comments on the report as well as comments on format and design leading to an improved product.

Harvey Averch
Acting Assistant Director
for Scientific, Technological,
and International Affairs

April 1977

acknowledgments

This report was prepared under the supervision of Thomas J. Hogan, Study Director, Industry Studies Group. The analysis of the data and the writing of the report were performed by John R. Chirichiello, Roberta A. McKenry, and Robert O. Santos. Lola E. Seidl assisted in the preparation of the material. Morris Cobern, Associate Study Director, Manpower Utilization Studies Group, was responsible for the analysis and statistical materials for the manpower section.

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HIGHLIGHTS

- Total R&D spending in the United States is estimated to reach $40.8 billion in 1977, 9 percent above the 1976 level of $37.3 billion. In constant dollars, the increase between the 2 years is estimated at 3 percent.

- Research and development is expected to account for 2.2 percent of the Nation's gross national product (GNP) in 1977. This ratio is the same as in 1976, but is down from a high of 3.0 percent in 1964.

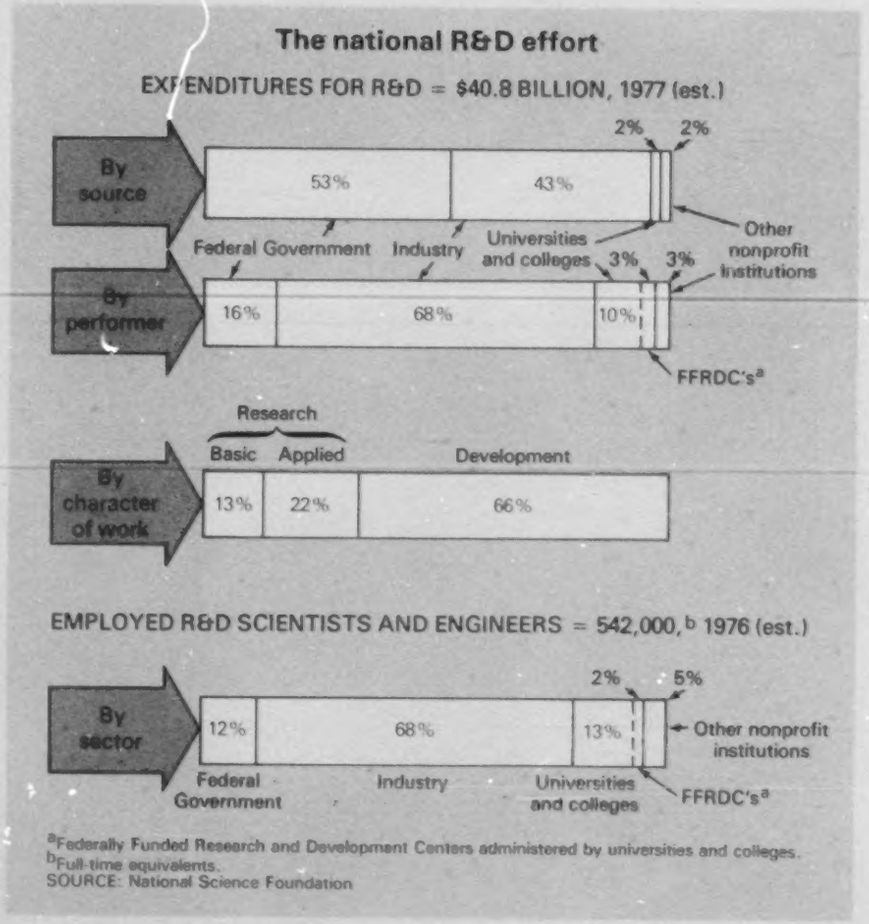
- In 1977 the Federal Government will support 53 percent of the U.S. R&D effort. About two-thirds of this support is for defense and space programs.

- Almost 35 percent of R&D spending in the United States is devoted to research. In 1977 basic research expenditures are estimated at $5.2 billion and applied research at $9.0 billion. Development spending is estimated at $26.6 billion.

- Over three-fifths of the Nation's basic research will be performed by universities and colleges in 1977. Industry is the leading performer of both applied research and development.

- R&D spending is expected to reach a level of about $38.2 billion by 1985, as measured in terms of 1972 dollars. This represents a compound growth rate of 3 percent over 1974 R&D expenditures.

- An estimated 542,000 R&D scientists and engineers were employed in the United States in 1976, 2 percent more than in 1975. Historically, about one-third of all scientists and engineers are employed in R&D activities.



R&D FUNDING PATTERNS

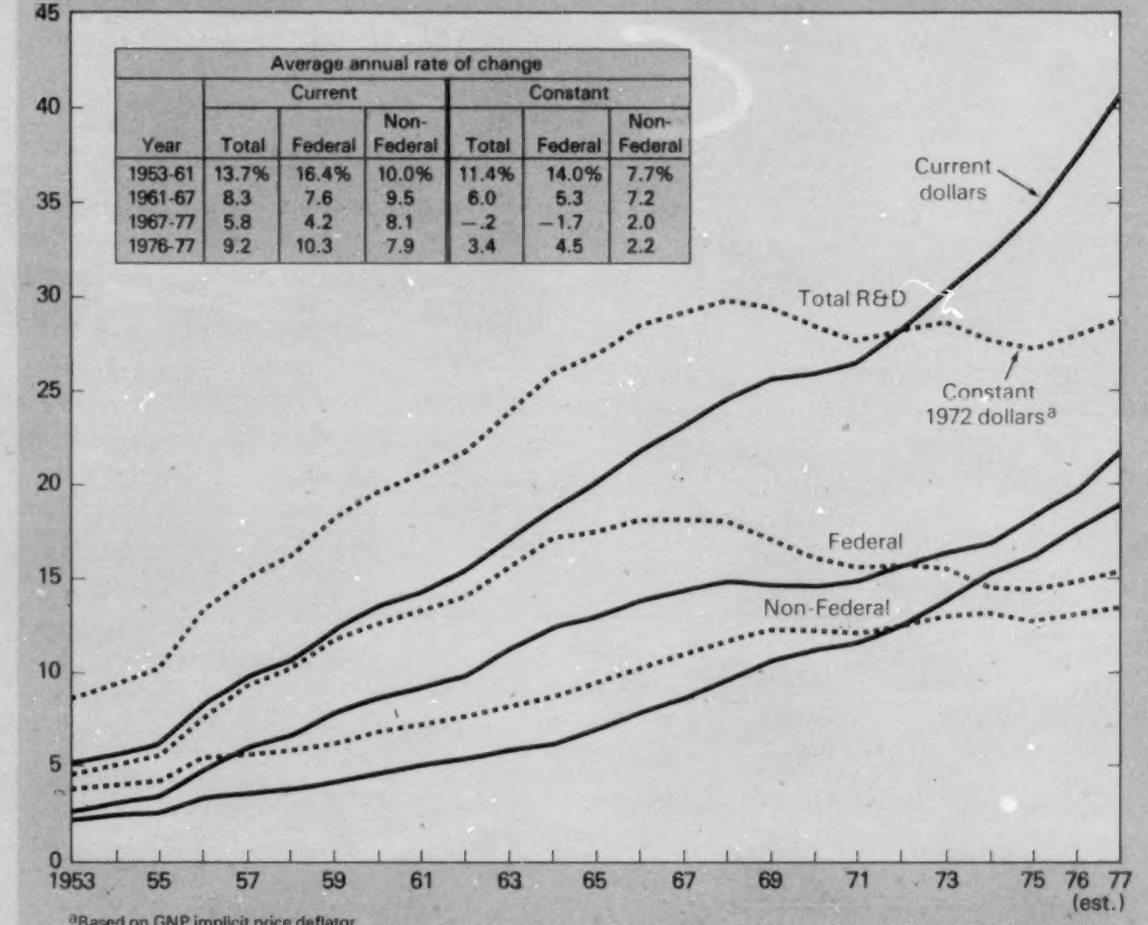
R&D spending within the United States has continued its pattern of current-dollar growth in recent years. In 1977 total U.S. R&D expenditures are expected to reach a level of $40.8 billion—9 percent above the 1976 amount and nearly 76 percent more than was spent on those activities a decade earlier. In constant dollars, assuming a 6-percent rate of inflation, an increase of 3 percent is expected between 1976 and 1977.[1] Federal Government spending on R&D activities is expected to increase from $19.8 billion in 1976 to $21.8 billion in 1977. The Federal support is expected to be greater in the areas of defense, space, and energy, and to decrease in the area of health. Non-Federal R&D spending is also expected to rise slightly in 1977, the largest percentage increases occurring in the universities and colleges and nonprofit institutions sectors (9 percent and 10 percent, respectively).

[1] In the absense of a reliable R&D cost index, the gross national product (GNP) implicit price deflator was used to convert R&D expenditures to constant dollars. The GNP deflator includes the effects of price changes for all goods and services in the economy and therefore can only indicate approximate changes in cost of inputs specifically related to R&D performance.

R&D funding trends 1953-77

(Billions of dollars)

Average annual rate of change						
	Current			Constant		
Year	Total	Federal	Non-Federal	Total	Federal	Non-Federal
1953-61	13.7%	16.4%	10.0%	11.4%	14.0%	7.7%
1961-67	8.3	7.6	9.5	6.0	5.3	7.2
1967-77	5.8	4.2	8.1	−.2	−1.7	2.0
1976-77	9.2	10.3	7.9	3.4	4.5	2.2

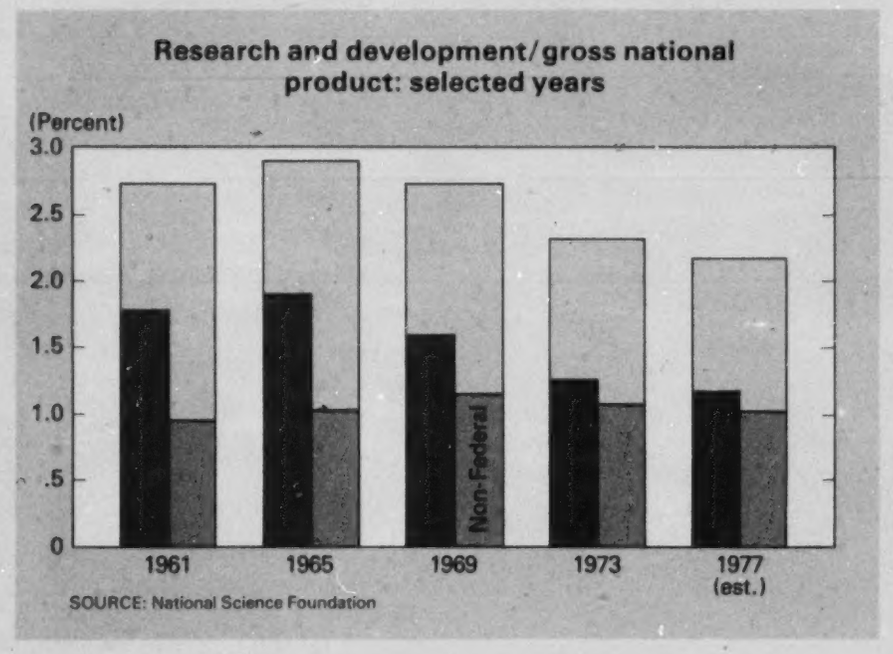


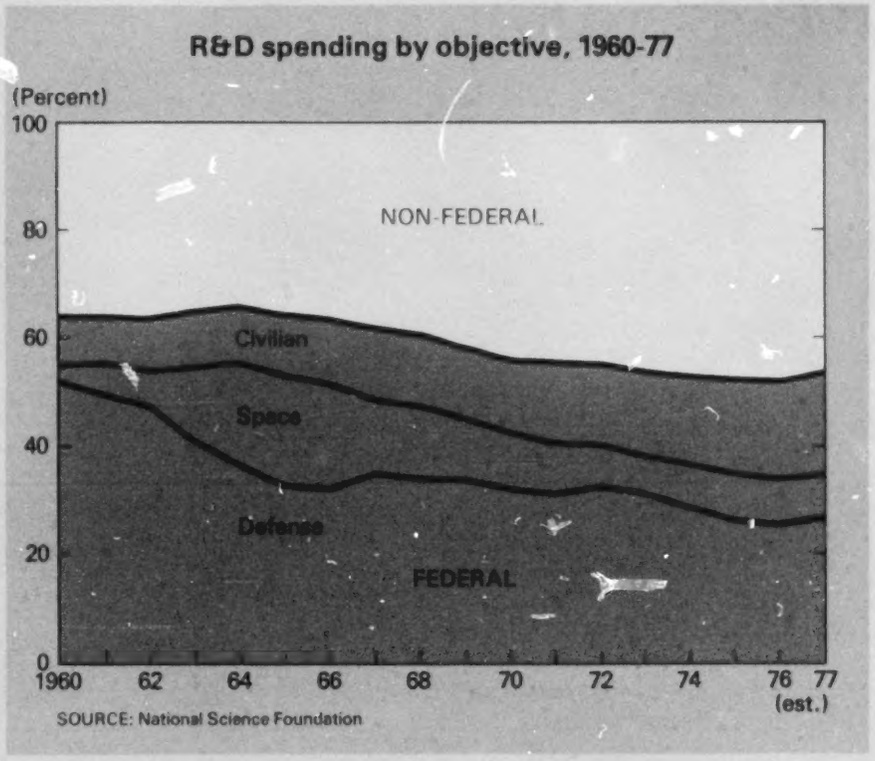
[a]Based on GNP implicit price deflator
SOURCE: National Science Foundation

R&D by Selected Objective

For the first time since 1964, combined defense and space-related activities are expected to increase as a proportion of total national R&D spending, rising from 34.6 percent in 1976 to 35.1 percent in 1977. Defense spending accounted for all of the increase, because of increases for advances in undersea warfare and air combat planes. Expenditures for defense and space-related research and development are estimated at almost $15 billion during 1977.

Civilian R&D support (Federal and non-Federal combined) is expected to total about $25 billion in 1977, or 65 percent of all R&D spending. The largest shares will go to the fields of health, energy, and environment. Federal funding of civilian R&D activities is expected to decline slightly in 1977. The non-Federal share has remained approximately at the level of 47 percent of total R&D funds since 1974.





R&D Comparisons

The relationship of R&D expenditures to the gross national product (GNP) affords a comparison, over time, of the priority of R&D activities in the economy.

In 1977 research and development is expected to amount to 2.2 percent of the GNP, the same as in 1976, but down from the 2.3 percent registered in 1975 and the 1964 high of 3.0 percent. The 9-percent increase in R&D expenditures between 1976 and 1977 combined with an estimated 11-percent increase in the GNP, has caused the ratio to remain at the same approximate level. The ratio is not expected to increase during the remainder of the decade.

R&D spending patterns of selected countries: 1970 and 1974

[Percents]

Country	R&D/GNP	
	1970	1974
United States	2.65	2.30
France	1.88	1.73
West Germany	2.14	2.25
Japan	1.86	1.99
United Kingdom	2.63	2.39

SOURCES: National Science Foundation and Organisation for Economic Cooperation and Development

The United States devoted a larger percent of its GNP to R&D activities in 1974 than did most other major R&D-performing countries for which data are available, because of its large expenditures on defense and space activities. The other countries, with the exception of the United Kingdom, do not spend large amounts in these areas.

Between 1970 and 1974 total R&D expenditures increased by 35 percent in the United States. The latest year for which data are available for other countries is 1974. Each of the other major Western R&D-performing countries, excepting the United Kingdom registered larger gains, the largest being in Japan—over 100 percent.

R&D Projections

R&D spending in the United States has been projected to 1985 by using several alternative sets of assumptions. These assumptions and rationale for their use are found in the report, *1985 R&D Funding Projections*,[2] which are based primarily on past trends. They are not predictions of R&D activity.

The GNP, expressed in 1972 dollars, is projected by the Bureau of Labor Statistics at $1.9 trillion in 1985. The R&D/GNP ratio is expected to decline from the 1976 ratio of 2.2 percent to 2.0 percent in 1985 because the GNP is expected to show a more rapid increase than R&D expenditures. Assuming a compound growth rate of 3 percent, R&D expenditures in 1985 are expected to reach $38.2 billion (1972 dollars), up from $27.8 billion in 1974.

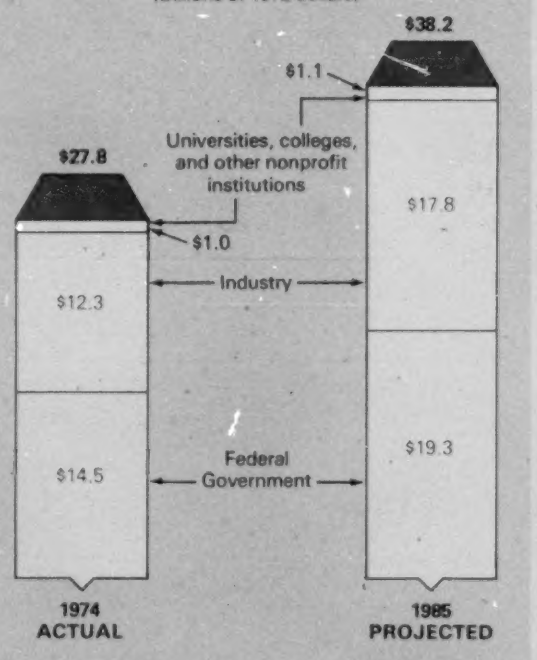
Industrial R&D spending in constant dollars is expected to grow at a compound rate of 3.5 percent between 1974 and 1985, mainly due to a projected annual increase of 6 percent in the chemicals industry. Nonmanufacturing industries, while representing a small share of the total, are also expected to show substantial annual growth in R&D expenditures—about 6 percent.

Federal R&D programs are expected to increase by some 33 percent from the $14.5 billion in 1974 to $19.3 billion in 1985, or by 2.6 percent per year. Defense spending, which accounts for 50 percent of the Federal R&D total, is the major cause of the projected increase. Industry is expected to remain the major performer of Federal research and development with over 50 percent of the Federal total. All performers' shares are expected to remain relatively stable until 1985.

These projections indicate a leveling of R&D spending by the Nation's universities and colleges and other nonprofit institutions, increasing only an average of 1 percent per year throughout the 1974-85 period. Federal R&D support of these institutions is projected to increase somewhat faster than non-Federal R&D support between 1974 and 1985.

Projections of R&D expenditures to 1985

(Billions of 1972 dollars)



SOURCE: National Science Foundation

[2] National Science Foundation, *1985 R&D Funding Projections* (NSF 76-314) (Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office, 1976.)

Transfers of Funds

Transfer tables permit intersectoral comparisons of the distribution of R&D funds, by both source of funds and performers of R&D activities. Data can be compared for the R&D aggregate or for its components—basic research, applied research, and development.

The Federal Government continues in its role as the leading supporter of research and development. Between 1972 and 1977, its share of the national R&D effort has remained relatively constant. In the past 10 years, however, from 1967 to 1977, the Federal share of the national R&D effort dropped from 61 percent to 53 percent. Industry, as the largest performer of research and development, is expected to claim about 48 percent of total Federal funds. Federal laboratories comprise the second largest recipient of Federal R&D funds, receiving about 30 percent of the funds.

The industry sector, second in size in support of R&D activities, is expected to show an 8-percent increase in funding between 1976 and 1977. In contrast to the wide distribution given Federal monies, the industry sector will spend $17.2 billion of the $17.5 billion allocated to research and development in its own laboratories.

Traditionally, the largest performer of basic research—universities and colleges—will expend over three-fifths, or $3.2 billion, of the $5.2 billion devoted to such activities in 1977.

Industry remains the largest performer of both applied research and development in 1977, claiming 56 percent and 82 percent, respectively, of such funds. Of the $9.0 billion total allocated to applied research, industry will provide $3.8 billion, or 42 percent; of the $26.6 billion allocated to development, industry will provide $13.0 billion, or 49 percent.

Intersectoral transfers of funds used for performance of research and development, basic research, applied research, and development: 1977 (estimates)

RESEARCH AND DEVELOPMENT[1]
[Dollars in millions]

Sources of funds	Performers					Total	Percent distribution, sources
	Federal Government	Industry[2]	Universities and colleges[3]	Associated FFRDC's[4]	Other nonprofit institutions[2]		
Federal Government	$6,500	$10,500	$2,634	$1,177	$987	$21,798	53.4
Industry	—	[5]17,250	134	—	124	17,508	42.9
Universities and colleges	—	—	[5]883	—	—	883	2.2
Other nonprofit institutions	—	—	305	—	[5]306	611	1.5
Total	6,500	27,750	3,956	1,177	1,417	40,800	
			5,133				
Percent distribution, performers	15.9	68.0	9.7	2.9	3.5		100.0
			12.6				

BASIC RESEARCH[1]
[Dollars in millions]

Sources of funds	Performers					Total	Percent distribution, sources
	Federal Government	Industry[2]	Universities and colleges[3]	Associated FFRDC's[4]	Other nonprofit institutions[2]		
Federal Government	$750	$175	$1,949	$366	$290	$3,530	68.2
Industry	—	[5]615	85	—	58	758	14.6
Universities and colleges	—	—	[5]564	—	—	564	10.9
Other nonprofit institutions	—	—	195	—	[5]131	326	6.3
Total	750	790	2,793	366	479	5,178	
			3,159				
Percent distribution, performers	14.5	15.2	53.9	7.1	9.3		100.0
			61.0				

All data are estimated from reports by performers.

[2] Expenditures for Federally Funded Research and Development Centers (FFRDC's) administered by both industry and by nonprofit institutions are included in the totals of their respective sectors. FFRDC's are organizations exclusively or substantially financed by the Federal Government to meet a particular requirement or to provide major facilities for research and training purposes.

[3] Includes agricultural experiment stations.

Intersectoral transfers of funds used for performance of research and development, basic research, applied research, and development: 1977 (estimated)—Con.

APPLIED RESEARCH[1]

[Dollars in millions]

Sources of funds	Performers					Total	Percent distribution, sources
	Federal Government	Industry[2]	Universities and colleges[3]	Associated FFRDC's[4]	Other nonprofit institutions[2]		
Federal Government	$2,050	$1,350	$595	$414	$345	$4,754	52.8
Industry	—	[5]3,700	40	—	42	3,782	42.0
Universities and colleges	—	—	[5]263	—	—	263	2.9
Other nonprofit institutions	—	—	91	—	[5]120	211	2.3
Total	2,050	5,050	989	414	507	9,010	
			1,403				
Percent distribution, performers	22.8	56.0	11.0	4.6	5.6		100.0
			15.6				

DEVELOPMENT[1]

[Dollars in millions]

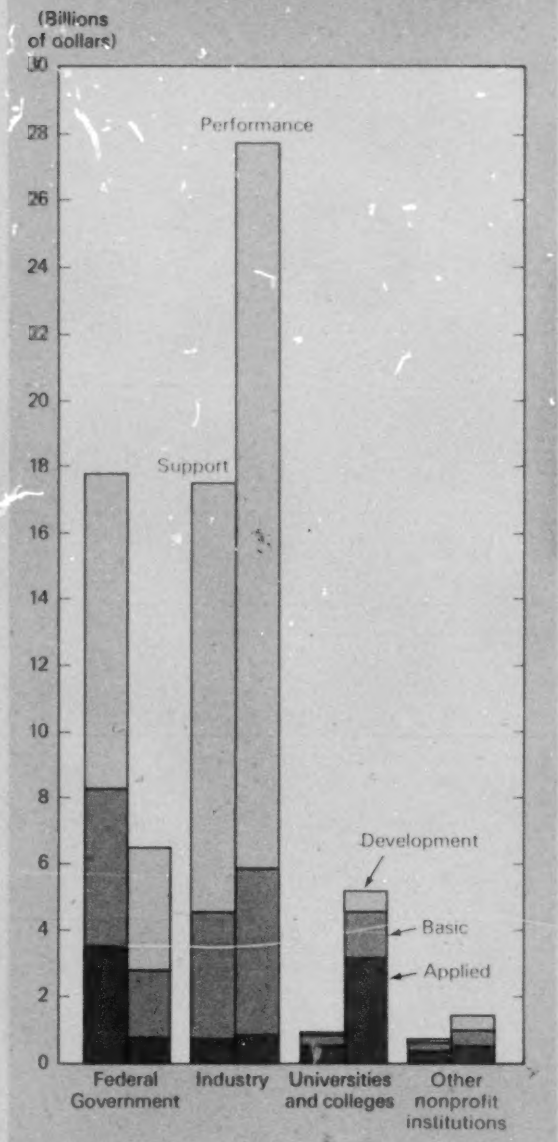
Sources of funds	Performers					Total	Percent distribution, sources
	Federal Government	Industry[2]	Universities and colleges[3]	Associated FFRDC's[4]	Other nonprofit institutions[2]		
Federal Government	$3,700	$8,975	$90	$397	$352	$13,514	50.8
Industry	—	[5]12,935	9	—	24	12,968	48.7
Universities and colleges	—	—	[5]56	—	—	56	2
Other nonprofit institutions	—	—	19	—	[5]55	74	3
Total	3,700	21,910	174	397	431	26,612	
			571				
Percent distribution, performers	13.9	82.3	.7	1.5	1.6		100.0
			2.2				

[1] Federally Funded Research and Development Centers (FFRDC's) administered by individual universities and colleges and by university consortia.

[2] Includes State and local government funds.

SOURCE: National Science Foundation

Support and performance of R&D in the United States: 1977 (est.)



SOURCE: National Science Foundation

Character of R&D Work

In 1977 basic research accounted for 13 percent of total R&D spending; applied research amounted to an additional 22 percent; and development accounted for the remaining 65 percent. The corresponding ratios in 1953 were 9 percent, 25 percent, and 66 percent, respectively.

BASIC RESEARCH

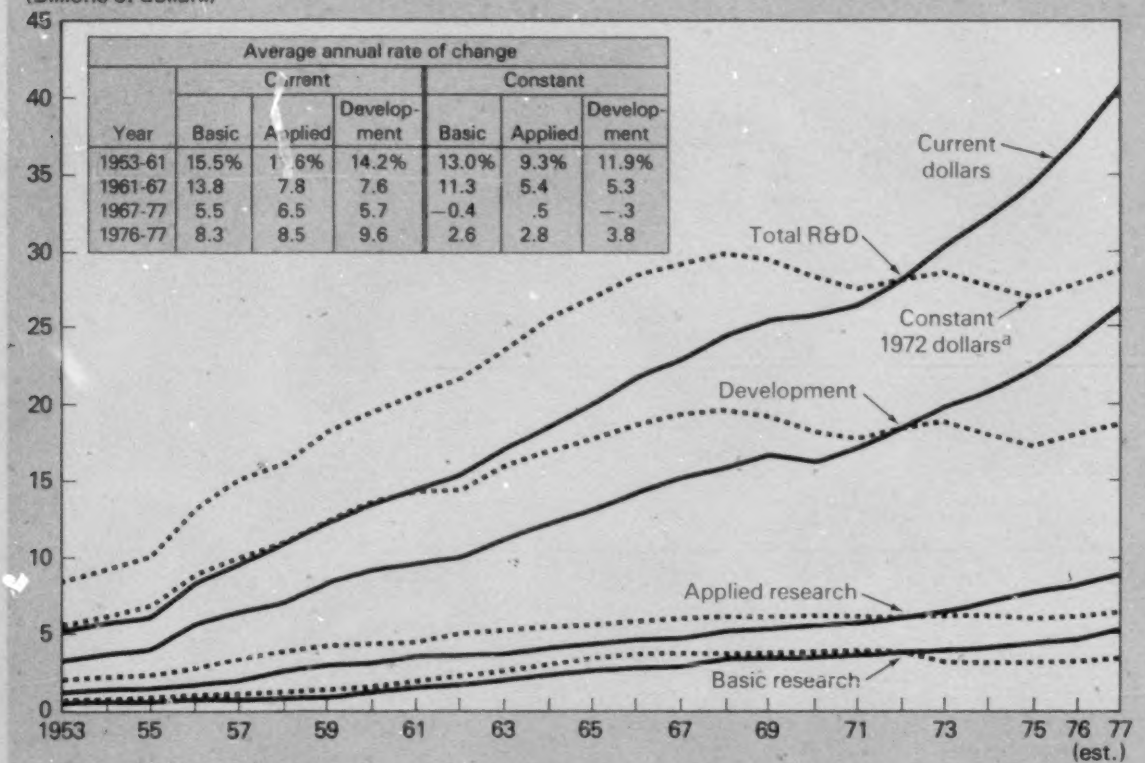
Total expenditures for basic research performance are anticipated to reach $5.2 billion in 1977—a gain of 8.3 percent over 1976. When measured in constant dollars the expected gain is 2 percent. During the decade 1967-77, basic research expenditures registered a gain of 70 percent in current dollars but were down 5 percent in constant dollars.

National R&D totals by character of work

(Billions of dollars)

Average annual rate of change

Year	Current			Constant		
	Basic	Applied	Development	Basic	Applied	Development
1953-61	15.5%	11.6%	14.2%	13.0%	9.3%	11.9%
1961-67	13.8	7.8	7.6	11.3	5.4	5.3
1967-77	5.5	6.5	5.7	−0.4	.5	−.3
1976-77	8.3	8.5	9.6	2.6	2.8	3.8



[a]Based on GNP implicit price deflator.
SOURCE: National Science Foundation

Universities and colleges are the primary performers of basic research. They are expected to conduct 54 percent of the total basic research effort in 1977—about the same as 1976. During the period 1953-77 universities and colleges increased their share of total basic research performance from 25 percent to 54 percent, because of increased Federal funding of basic research in the university sector. There were corresponding decreases in Federal Government and industrial performance—23 percent to 14 percent, and 34 percent to 15 percent, respectively. In recent years, basic research performance has been decreasing in industry because of greater short-term R&D emphasis in that sector.

In 1977 the Federal Government is expected to finance 68 percent of total basic research—almost the same share as in 1975 and 1976. Between 1976 and 1977, Federal Government support is expected to increase by 8.5 percent, due mostly to increases in energy, food, and environmental research.

Industry is expected to finance 15 percent of total basic research in 1977, as compared with 35 percent in 1953. This is a result of the recent short-term emphasis in industrial R&D spending. Traditionally, the industries which fund almost all basic research supported by industry are the chemicals industry, the electrical equipment industry, and the aerospace industry. Industry spends a relatively low percentage of its total R&D dollars on basic research. In 1977 basic research is anticipated to account for 4 percent of total industrial R&D dollars.

Universities' and colleges' funding of basic research is expected to show a gain from 7 percent in 1967 to 11 percent in 1977, due to a

corresponding decrease in the percentage of Federal funds devoted to basic research. This sector is expected to assign 64 percent of its total R&D funds to basic research in 1977 since the environment in the universities is particularly favorable for the performance of basic research.

Nonprofit institutions are expected to finance 6 percent of basic research in 1977 as compared with 5 percent in 1967. They contribute about one-half of their R&D funds to basic research.

APPLIED RESEARCH

Applied research performance is expected to reach $9.0 billion in 1977—9 percent more than the 1976 level. In constant dollars, the expenditures will rise 2 percent. Total expenditures for applied research in constant dollars have remained relatively level since 1968.

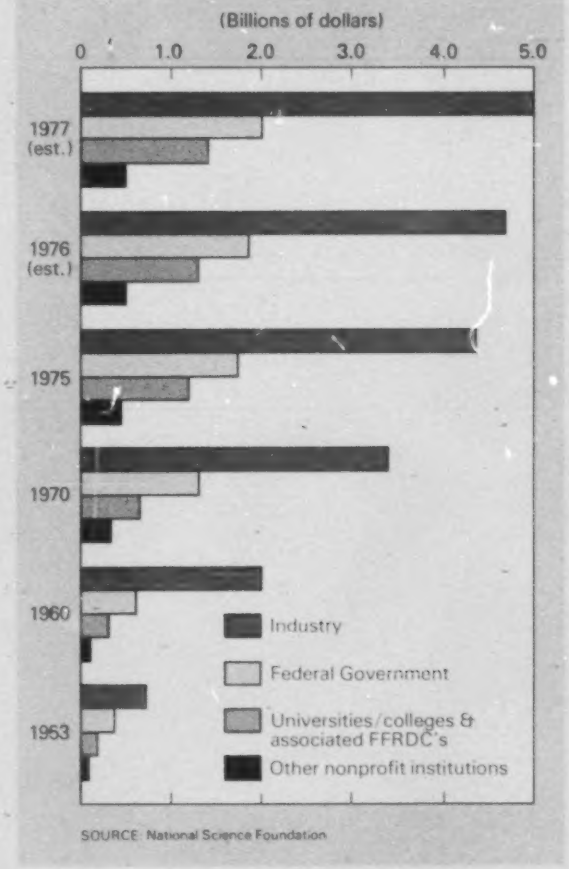
In 1977 the proportion of total R&D performance devoted to applied research is anticipated to be 22 percent, about the same percent as in 1976. This ratio has remained relatively unchanged in recent years.

The industry sector is anticipated to conduct 56 percent of total applied research in 1977. This sector has been the major performer of applied research since 1953, when NSF began surveying R&D activities; its share of applied research performance, however, has decreased from 71 percent in 1958, because of increased applied research performance by universities and nonprofit institutions.

In 1977 industrial firms are expected to spend $3.8 billion on applied research, or 22 percent of their total R&D dollars. The major performers of applied research in industry are the chemicals, electrical equipment and communications, and aircraft and missiles industries.

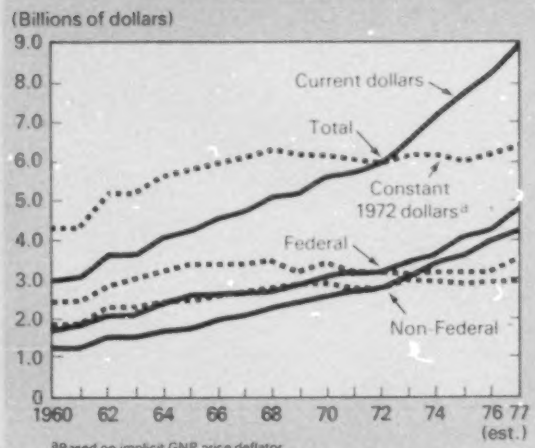
The Federal Government is expected to account for about 23 percent of applied research performance in 1977 mostly in the areas of health, defense, and agriculture.

Applied research performance: selected years



SOURCE: National Science Foundation

Federal & non-Federal financing of applied research: 1960-77



[a]Based on implicit GNP price deflator.
SOURCE: National Science Foundation

In 1977 the Federal Government will furnish 53 percent of total applied research funds. Most of these funds are used intramurally or are allocated to industry. Since 1953 the Federal Government has been the primary source of funds for applied research.

Industry is the next largest source of applied research financing. In 1977 it is expected to finance 42 percent of all applied research, about the same proportion as in 1972. The three industries financing the largest amount of basic research are also the greatest supporters of applied research. Universities and colleges and other nonprofit institutions are expected to contribute the remaining 5 percent of the total applied research funds in 1977.

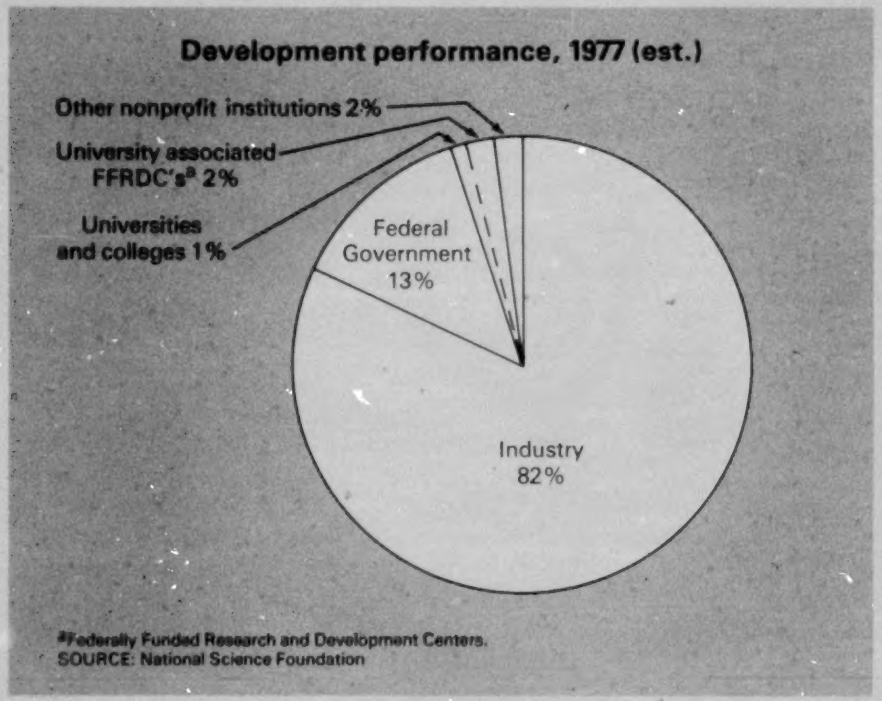
Expenditures for development by all sectors are estimated to reach $26.6 billion in 1977—a gain of 10 percent over 1976.

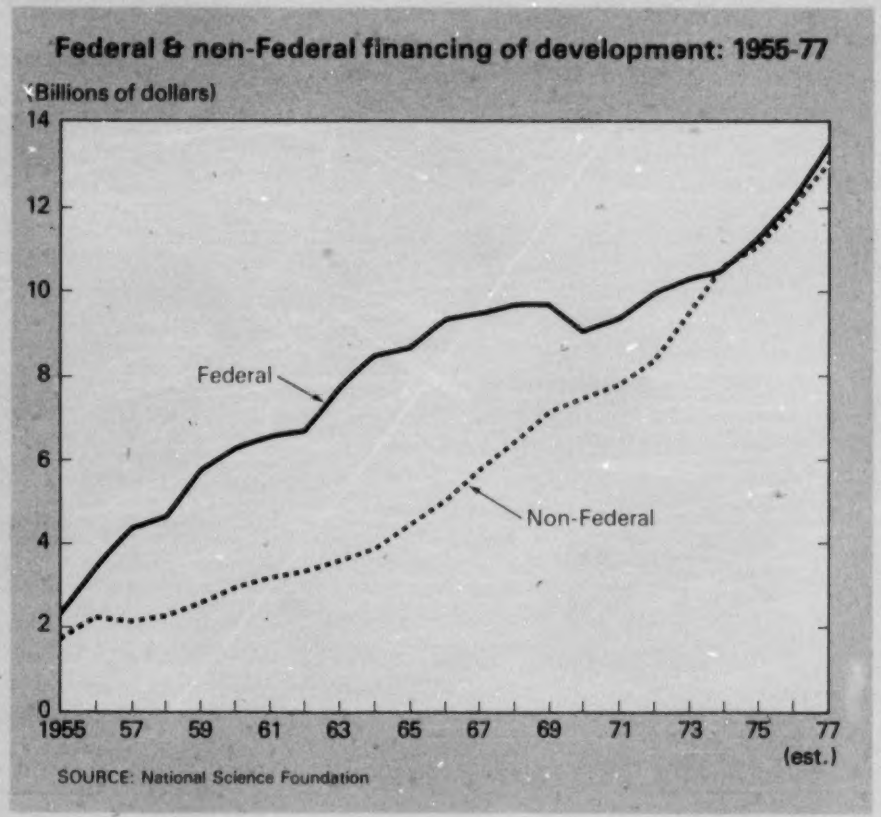
Development activities hold a significant role in the total R&D effort. The proportional share of development in total R&D performance has always been more than 60 percent.

The industrial sector is the major performer of development activities. In 1977 this sector is expected to account for 82 percent of total development performance as compared with 81 percent in 1953. Because a primary goal of industrial firms is to increase their profits, they direct the bulk of their expenditures on activities related to translating research findings into new and improved products and processes. In 1977 industrial firms are expected to spend 74 percent of their total R&D outlays on development, compared with 22 percent on applied research, and 4 percent on basic research.

The Federal Government is the largest source of funds for development. In 1977 it is expected to finance 51 percent or $13.5 million of all development, concentrating in defense, space, and energy fields. This gain of 10 percent over 1976 results mostly from defense increases.

It is anticipated that the industrial sector will contribute $13.0 million to development in 1977—a gain of 8 percent over 1976. This sector is expected to finance 47 percent of all development activities, about the same percent as in 1976.



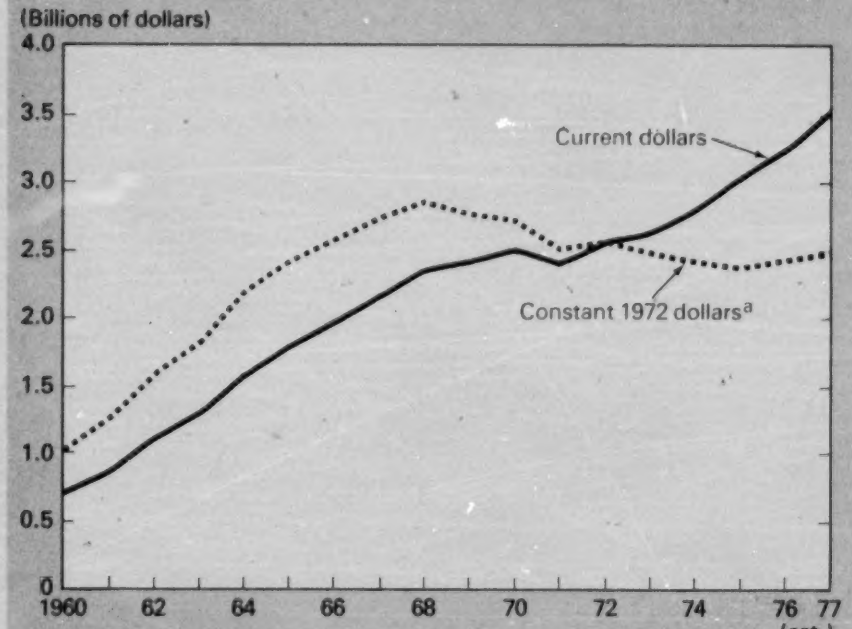


FEDERAL GOVERNMENT

A significant volume of research and development is performed within Government facilities. This intramural performance is expected to amount to about 16 percent, or $6.5 billion of the 1977 R&D total. This represents 30 percent of Federal funds spent on research and development, an increase of 12 percent over the previous year's total.

The Federal Government will continue to supply the bulk of R&D funds to the U.S. economy in 1977. It is expected to provide $21.8 billion, or 53 percent of all R&D funds—about the same percentage as last year.

Federal support for basic research: 1960-77



[a]Based on GNP implicit price deflator
SOURCE: National Science Foundation

Totals reported for Federal funding may be understated since many industrial firms report as company funds rather than Federal the cost associated with projects which are conducted in the hope of obtaining Federal contracts.

Character of Work

Federal agencies generally conduct basic research in their own laboratories as part of larger R&D efforts in fields related to thir mission. In 977 about 12 percent of Federal intramural R&D spending will be for basic research. This ratio has remained relatively constant for the past 5 years. Although a few Federal agencies perform all of their basic research intramurally, most agencies rely heavily on outside contractors, primarily universities.

The remaining 88 percent of intramural R&D work in 1977 will be spent on applied research and development programs, e.g., studies in undersea warfare, aircraft programs such as the B-1 bomber, coal utilization, solar energy development, space shuttle, and various atomic energy programs.

Future of Research and Development

The basic relationship between man and his environment is expected, in this decade, to assume a greater role in the achievement of technological progress. Scientists and administrators increasingly stress that the consequence of the rise of new knowledge should be carefully weighed. This caveat is likely to receive even greater emphasis in the future. There is a growing recognition that the effects of technological innovations should be more thoroughly assessed if technology is to serve human needs more efficiently.

This present situation leads to increased interest in multidisciplinary approaches to public problems. More R&D programs conducted by individual agencies are likely to draw upon a number of disciplines and be part of larger areas of exploration. In addition, the work of one agency is often applicable to that of another. For example, the systems approach, which has been highly refined by the Department of Defense and the National Aeronautics and Space Administration, has been applied by other agencies to such problems as mass transportation, crime reduction, and environmental control.

INDUSTRY

Industrial firms are expected to spend nearly $27.8 billion on research and development during 1977. This represents a 43-percent increase since 1972. Industry presently accounts for 68 percent of total R&D performance in the United States and is expected to continue in this dominant role.

Industry will receive 38 percent of its funds from the Federal Government in 1977 and will finance the remainder from its own funds. This is consistent with the trend begun in the late sixties when Federal R&D contract monies began to level off.

Industry's Role

A relatively small portion of total intramural industrial R&D spending is devoted to basic research—$615 million or 3.6 percent in 1977. Although a substantially greater amount is directed into applied research, industry's primary role is in the area of development.

The greater commitment to applied research—$3.7 billion in 1977, and development, $12.9 billion—reflects industry's emphasis on producing new or improved products or processes. Unlike basic research, applied research and development projects are generally of a shorter time duration, thus leading to faster commercial payoff.

Leading Industries

In 1974 the five leading R&D-performing industries—electrical equipment and communication, aircraft and missiles, machinery, motor vehicles and other transportation equipment, and chemicals—spent over 80 percent of total industrial R&D funds. Companies in the first two industries accounted for nearly one-half of the industrial total.

All of these industries, except aircraft and missiles, steadily increased their R&D spending over the past decade. The aircraft and missiles industry also showed R&D increases between 1965 and 1969, but thereafter showed a decline because of decreased emphasis on Federal defense and space programs.

UNIVERSITIES AND COLLEGES

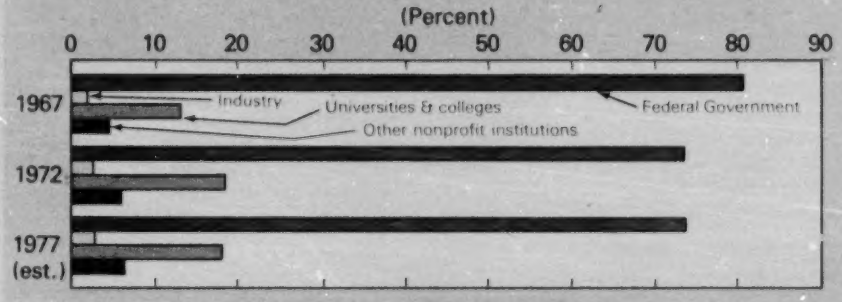
Universities and colleges are the major performers of basic research in the country, accounting for over one-half of the national total. These institutions devote more than three-quarters of their R&D efforts to basic research activities. The intellectual environment of the university or college setting is particularly appropriate to the conduct of basic research to add to and transmit the store of scientific knowledge. In addition, graduate education and research activities are closely related.

Funding

Federal agencies contribute about two-thirds of the funds used for R&D performance by universities and colleges. Many agencies draw on the expertise of university personnel to advance their own programs, especially in scientific areas where their capabilities may be limited. Also, Federal R&D support has been geared to strengthen the universities' capabilities and encourage a broader base for science in the Nation.

Universities and colleges also perform research and development for industrial firms, State and local governments, and nonprofit organizations. Together with universities' own funds, these sources account for the remaining one-third of R&D funds expended by universities and colleges.

Basic research performed by universities and colleges[a] by source of funds: selected years



[a]Includes Federally Funded Research and Development Centers.
SOURCE: National Science Foundation

NONPROFIT INSTITUTIONS

A variety of organizations are contained in the fourth sector of the economy, as defined in this report. Nonprofit institutions include research institutes, philanthropic foundations, professional and technical societies, academies of science, voluntary as well as State and local hospitals, science museums, zoological parks, botanical gardens, and arboretums. These organizations pursue widely differing programs in promoting scientific effort, and despite relatively limited R&D expenditures, account for significant contributions in many fields.

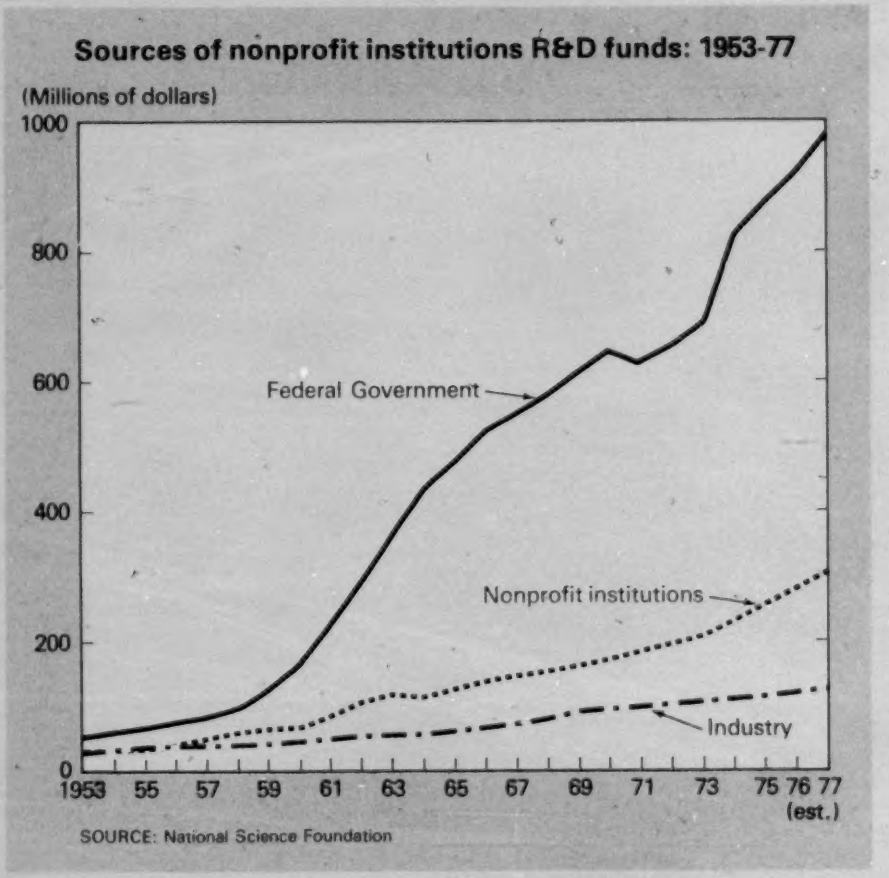
In 1977 the nonprofit sector is expected to account for about $1.4 billion in R&D performance, about the same level as in 1976. This amount represents only a slight increase during the preceding 5 years.

Research institutes concentrate on the performance of research and development, mainly financed by Government and industry contracts. Leading research institutes include Stanford Research Institute and Battelle Memorial Institute.

Philanthropic foundations are significant sources of research grant money, financing innovative efforts in particular, generally from endowment funds. The Ford Foundation, John A. Hartford Foundation, and the Rockefeller Foundation are leaders in this category. Philanthropic foundations have aided in numerous health advances.

Scientific societies and academies of science are primarily active in collecting and disseminating scientific knowledge through conferences, symposia, and publication of journals and reports. Science museums, zoos, and similar institutions are exhibitors and interpreters of science, as well as research performers.

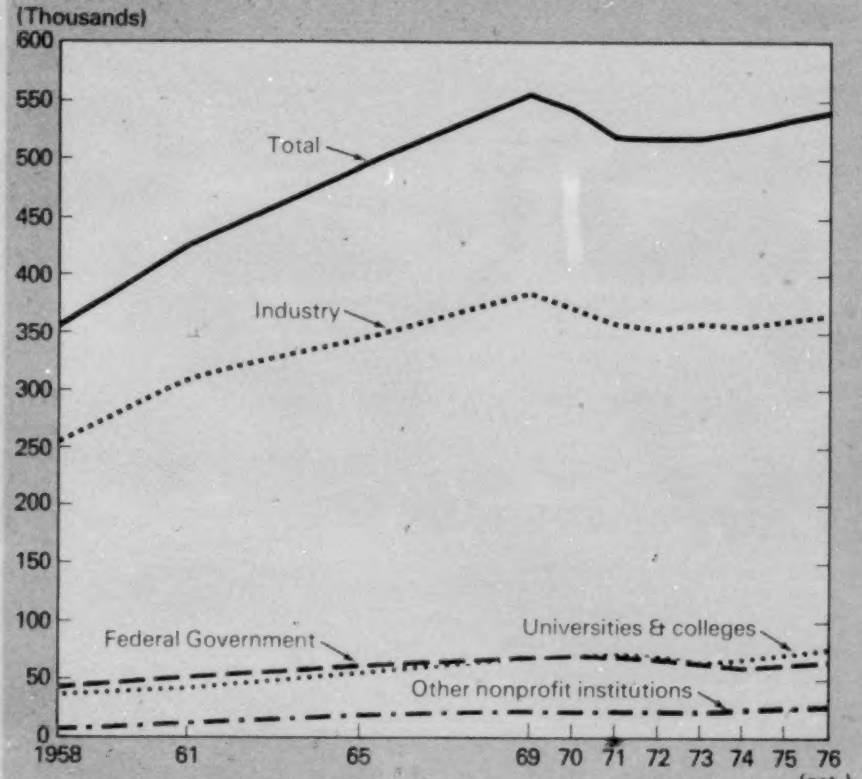
Nonprofit institutions have received about three-fifths of their R&D support from the Federal Government in recent years. Financing by the industry sector, although the smallest component of the nonprofit sector's funding, continues to increase.



R&D MANPOWER

About 540,000 scientists and engineers were engaged in R&D activities on a full-time-equivalent (FTE) basis during 1976 in all sectors of the economy. This level is a result of 4 years of employment increases since the 1972 trough of 519,000, and represents a recovery of over one-half the 40,000 jobs lost between 1969 and 1973. All sectors of the economy participated in the recovery.

Full-time-equivalent scientists and engineers employed in R&D by sector: selected years



SOURCE: National Science Foundation

The industrial sector, however, contributed the least to the increase in total R&D employment, while universities and other nonprofit institutions grew at the fastest rates since 1973. Thus, the share of all R&D scientists and engineers employed by industry has declined from about 73 percent in the early sixties to 69 percent by 1969 and to 67 percent by 1976.

Scientists and engineers engaged in research and development represented about one-third of all persons employed as scientists and engineers. According to the latest available data reflecting primary work activities in 1974, 30 percent of scientists and engineers were in R&D performance, and another 9 percent were in R&D management. Proportionately more engineers than scientists were in performance, 34 percent versus 25 percent, as well as in management, 9 percent versus 8 percent, respectively.

Women accounted for about 5 percent of all R&D scientists and engineers in 1974, a smaller share than the 6 percent they represented of all employed scientists and engineers. Women engineers were more apt to be engaged in research than their scientist counterparts. While women engineers represented only 4 percent of all women in science and engineering, they comprised 7 percent of these women primarily engaged in R&D activities.

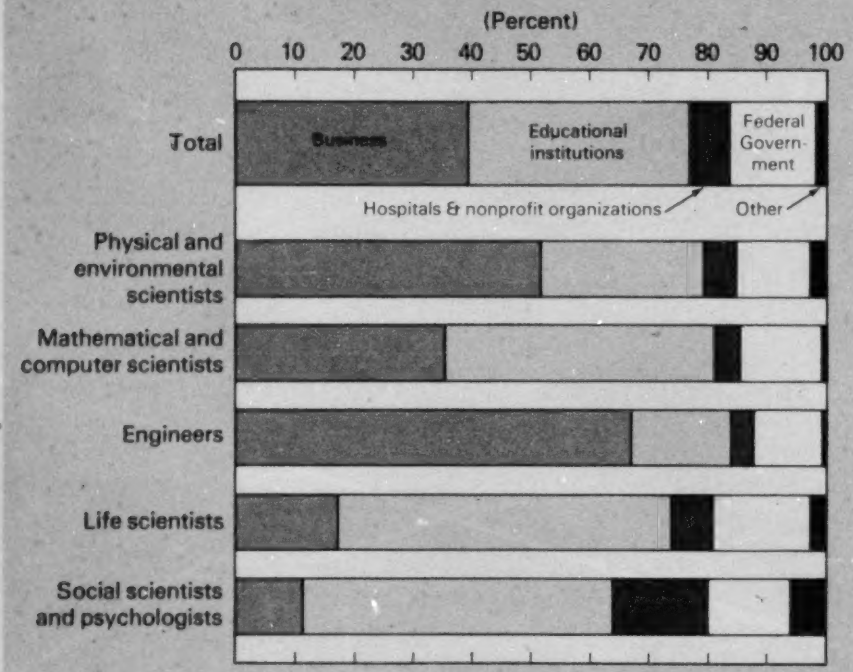
Of all scientists and engineers who were primarily working in research and development during 1974, two-thirds were doing development work, of whom eight in ten were engineers. Scientists predominated among the research activities representing 91 percent of those engaged in basic research and almost two-thirds of those in applied research.

The 121,000 scientists and engineers with doctorate degrees primarily engaged in research and development and R&D management in 1975 represented about one-fifth of all R&D scientists and engineers and two-fifths of all doctorates in science and engineering. About 40 percent were employed by private industry, two-thirds of whom were chemists. Another 37 percent were employed by academic institutions,

one-half being physicists, biological and agricultural scientists.[3] The remaining significant employer of doctorate R&D workers was the Federal Government which employed 14 percent of the total. Biological scientists, engineers, and physicists were the most numerous occupations represented in this sector.

[3] Additional workers in academic institutions indicated that research and development was a secondary activity. These are not represented in these data but are accounted for in the full-time-equivalent estimates in table B-10.

Doctorate scientists and engineers primarily engaged in the performance or administration of R&D, by field and sector: 1975



SOURCE: National Science Foundation

About 73,000 of these workers were primarily performing research, divided almost equally between basic (with 39,000) and applied (with 34,000) research activities. Another 12,000 were in developmental activities.

Most of the basic research workers were employed by the academic sector, while private industries employed the largest number of those engaged in applied research and development.

One-half of the 37,000 doctorates in R&D management were employed by industry, and the field composition reflected the sector's employment, with physical and environmental scientists and engineers comprising the bulk of employment.

It is significant to note that between 1973 and 1975 the growth of doctorate R&D scientists and engineers exceeded that of all R&D scientists and engineers. In the 2-year period the total FTE employment in all sectors increased by 13,300 (2.6 percent) from 520,400 to 533,700, while doctorates primarily engaged in research and development and R&D management increased by 23,500 (24 percent) from 97,800 to 121,300 between 1973 and 1975. It is likely that this occurred because of the ample supply of new doctorates combined with the slow growth of R&D job opportunities.

The academic and industrial sectors experienced the largest numerical and percentage gains of doctorate R&D employment, growing by more than 10,000 and about 30 percent each in the 2-year period. Doctorates—in all sectors—primarily engaged in R&D management increased considerably faster (by 30 percent) than those in R&D performance (22 percent). The growth in the management function was particularly marked in academic institutions, which registered a 55-percent growth in the period. These changes of total and doctorate R&D employment imply that a large proportion of R&D jobs that resulted from both growth and replacement needs were filled by doctorates who, in many instances, replaced nondoctorates or obtained jobs which were previously designed to be filled by nondoctorates.

Industry

During 1975 the FTE employment of R&D scientists and engineers in private industry increased by only 2,100, reaching 362,500 in January 1976. This level continues the slow recovery from the 350,000 low reached in 1972 after declining by 37,000 from the peak employment of 1969. The changes within industry groups, however, varied. Those experiencing the largest growth in FTE R&D employment were chemicals (1,700) and nonmanufacturing (1,200). The biggest losers were machinery and motor vehicles and other transportation equipment which declined by 900 each.

Full-time-equivalent number of R&D scientists and engineers, by industry: January 1957-76[1]

[In thousands]

Industry	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1975	1976
Total	229.4	243.8	268.4	292.0	312.1	310.8	327.3	340.2	343.6	353.2	367.2	376.7	387.1	384.1	366.8	349.9	363.1	360.4	362.5
Chemicals and allied products	29.4	31.0	33.5	36.1	37.0	36.5	38.3	35.3	37.9	38.6	36.9	38.9	40.3	40.2	42.8	40.9	40.7	44.9	46.6
Petroleum refining and extraction	6.9	7.4	7.7	9.2	9.0	9.1	8.9	8.1	8.7	8.9	8.7	9.2	10.0	9.9	9.2	8.3	8.2	8.4	8.8
Rubber products	4.7	4.7	4.8	5.3	5.5	5.6	5.8	6.0	5.8	5.7	5.8	6.1	6.3	6.6	5.9	5.8	5.8	6.1	6.1
Stone, clay, and glass products	[2]	[2]	[2]	[2]	3.6	3.7	3.8	3.3	3.5	3.1	3.3	4.1	4.2	4.6	4.1	3.9	3.9	4.1	4.2
Primary metals	5.1	5.2	5.7	6.9	6.9	6.0	5.2	5.1	5.5	5.5	5.9	5.9	6.2	6.3	6.3	6.0	5.5	5.5	5.9
Fabricated metal products	8.4	8.3	8.9	7.4	8.6	7.4	6.8	7.0	6.6	6.3	6.3	5.6	6.6	5.9	6.9	6.4	6.5	7.1	7.0
Machinery	24.9	27.4	29.4	32.1	33.0	31.5	31.4	27.3	29.4	30.5	33.6	37.4	39.4	41.4	40.5	41.1	41.7	43.6	42.7
Electrical equipment and communication	42.9	47.9	54.8	72.1	79.2	82.3	85.8	89.5	87.8	92.0	98.6	98.4	101.6	102.4	95.2	87.7	92.6	95.0	94.5
Motor vehicles and other transportation equipment	13.6	15.0	16.8	17.8	19.1	20.8	21.1	23.3	24.1	24.8	25.2	24.3	25.0	25.1	27.8	29.3	29.2	27.0	26.1
Aircraft and missiles	58.7	58.6	65.9	72.4	78.5	79.4	90.7	101.1	99.2	99.3	100.4	101.1	99.9	92.6	78.3	71.2	72.3	67.6	67.4
Professional and scientific instruments	10.2	11.0	12.0	10.0	11.1	9.8	9.4	10.8	11.5	12.5	13.0	14.1	15.1	14.8	15.1	15.1	15.9	16.5	17.1
Other manufacturing industries					12.9	11.7	11.9	13.6	14.0	14.3	15.4	16.5	17.4	17.8	19.1	18.5	25.5	19.7	20.0
Other nonmanufacturing industries	[3]24.6	[3]27.3	[3]28.9	[3]22.6	7.5	7.0	8.2	9.8	9.6	11.7	14.1	15.1	15.1	16.3	15.6	15.7	15.3	14.9	16.1

[1] Excludes social scientists.

[2] Data included in the "other manufacturing" group.

[3] For years 1957-60, other manufacturing and nonmanufacturing combined. Other manufacturing industries include food and kindred products; textiles; apparel; lumber and wood products; paper and allied products; tobacco products; printing and publishing; leather products and miscellaneous manufacturing.

SOURCE: National Science Foundation.

Universities and Colleges

Employment of scientists and engineers primarily engaged in research and development in the academic sector grew by 1,000 in 1975, reaching 51,000 in January 1976, the highest overall level yet attained. Other physical scientists (mainly environmental scientists), social and life scientists, chemists, and mathematicians contributed to this growth, reflecting changes in the subject composition of research activities in these institutions. Environmental, social, and life scientists each recorded new record employment levels, while chemists and mathematicians made recoveries bringing them close to former high levels. On the other hand, engineers and physicists both experienced continuations of declining employment which began in 1973.

The employment level of graduate S/E students in part-time R&D work continued its almost constant growth of the past during 1975 exceeding 40,000 for the first time, thereby increasing by nearly 50 percent over the 1965 levels. While employment of this group has been the fastest growing segment of the R&D workforce, it has paralleled overall growth in graduate enrollments. Hence, while 14 percent of graduate students in science and engineering were engaged part time in research and development in 1965, the percentage in 1976 was only slightly higher at 15 percent of enrolled students.

Among the specialties in 1965, nearly 25 percent of the life science graduate enrollees were engaged in R&D work as were 22 percent of those in physical sciences, 4 percent in mathematics, 7 percent in social sciences, and 11 percent in engineering. By 1976 the relative involvement in research and development among fields had changed, with 26 percent of those in physical sciences, 20 percent in life sciences, 9 percent in social sciences, 5 percent in mathematics, and 19 percent in engineering being engaged part time.

More than 13,000 scientists and engineers in the 21 FFRDC's associated with academic institutions were primarily R&D workers in January 1976, the largest number in history. One-half the increase between the Januarys of 1975 and 1976 resulted from a growth of nearly 400 astronomers and environmental scientists. Engineers, physicists, mathematicians, and life scientists were responsible for the remaining growth, while chemists and social scientists experienced declining employment during 1975.

Number of scientists and engineers primarily engaged in research and development in universities and colleges by field of specialization: January of selected years[1]

[In thousands]

Field of specialization	1965	1969	1971	1973	1974	1975	1976
All fields	40.0	47.1	48.3	46.6	47.4	50.0	51.0
Engineering	4.2	5.0	4.8	5.0	4.9	4.8	4.7
Physical and environmental sciences	5.9	7.0	7.3	7.9	8.3	8.1	8.6
Chemistry	2.3	2.9	2.6	2.8	3.0	2.8	2.9
Physics	2.1	2.4	2.4	2.5	2.5	2.4	2.4
Other	1.5	1.9	2.3	2.7	2.8	2.9	3.2
Mathematics	.9	1.7	1.4	1.3	1.5	1.5	1.6
Life sciences	25.0	28.3	30.4	28.0	28.0	30.6	30.8
Social sciences and psychology[2]	4.0	5.2	4.2	4.4	4.7	5.0	5.3

[1] Excludes graduate students.
[2] Excludes history.

NOTE: Components may not add to totals because of independent rounding.
SOURCE: National Science Foundation.

Number of graduate students engaged part time in research and development by field of specilization: January of selected years[1]

[In thousands]

Field of specialization	1965	1969	1971	1973	1974	1975	1976
All fields	27.2	35.8	37.2	34.6	36.9	39.7	40.2
Engineering	6.4	7.9	8.9	8.4	9.4	11.1	11.0
Physical and environmental sciences	8.1	10.6	10.5	8.8	9.2	9.0	9.2
Mathematics	.9	1.6	1.5	1.5	1.5	1.4	1.3
Life sciences	8.5	10.0	11.2	10.5	10.7	10.8	11.4
Social sciences and psychology[2]	3.3	5.7	5.1	5.4	6.2	7.4	7.3

[1] Based on data obtained in the NSF Survey of Scientific and Engineering Personnel Employed at Universities and Colleges for 1965-74, and the Survey of Graduate Science Student Support and Postdoctorals for the years 1975-76. See technical notes.
[2] Excludes history.

NOTE: Components may not add to totals because of independent rounding.
SOURCE: National Science Foundation.

Federal Government

Employment of R&D scientists and engineers by the Federal Government has remained virtually unchanged throughout the 1967-76 decade, ranging from about 45,000 to 48,000. In early 1976, 48,400 of these workers were employed—one-half by the Department of Defense (DOD) and its component agencies. Other agencies employing major shares of this employment were National Aeronautics and Space Administration (NASA), the Departments of Agriculture (USDA), Interior, Health, Education and Welfare (HEW), and Commerce. Scientists represented more than one-half these R&D workers, with physical scientists, especially chemists and physicists, predominating, followed by life scientists. Although the DOD was the largest single employer of scientists, the civilian agencies employed about 60 percent of their total employment—centered in USDA, HEW, and Interior. Additional R&D scientists and engineers are in the military services and managing R&D activities. These are included in the estimates shown in table B-10.

Other Sectors

Current survey data on the R&D scientist and engineer employment in nonprofit research organizations and State and local governments are not available. It is estimated, however, that nonprofit research organizations employed almost 31,000 R&D scientists and engineers in early 1976. This represented the highest level of employment these organizations have attained. As in past years, it was also estimated that life scientists and engineers together accounted for more than one-half of the nonprofits' R&D employment.

When last surveyed in 1973, State and local governments employed about 5,000 R&D scientists and engineers, primarily in the most populous States. Natural resources and health were the predominant functional areas of these workers, each with about 2,000 of the total employment.

Number of scientists and engineers primarily engaged in research and development in Federally Funded Research and Development Centers[1] by field of specialization: January of selected years

[In thousands]

Field of specialization	1965	1969	1971	1973	1974	1975	1976
All fields	10.8	11.3	11.1	11.8	11.9	12.4	13.1
Engineering	4.9	5.0	5.0	5.6	5.6	5.8	5.9
Physical and environmental sciences	4.2	4.3	4.2	4.4	4.6	4.7	5.2
Chemistry	1.2	1.2	1.2	1.2	1.1	1.2	1.2
Physics	2.3	2.6	2.6	2.7	2.8	2.9	3.0
Other	.6	.4	.5	.5	.7	.6	.9
Mathematics	1.0	1.1	1.1	1.1	1.0	1.3	1.3
Life sciences	.6	.4	.4	.5	.5	.5	.6
Social sciences and psychology[2]	.2	.5	.4	.2	.2	.1	.1

[1] Administered by universities and colleges.
[2] Excludes history.
NOTE: Components may not add to totals because of independent rounding.
SOURCE: National Science Foundation.

Distribution of civilian R&D scientists and engineers in the Federal Government, by agency and occupation: January 1976

Agency	Total	Engineers	Physical and environmental scientists	Mathematicians, statisticians, and computer scientists	Biological scientists	Social scientists
Total (in thousands)	48.4	23.3	13.9	3.3	5.7	2.1
	Percent distribution					
Department of Defense	51.4	66.5	40.0	78.6	8.3	56.0
Department of Agriculture	9.2	2.0	7.4	2.5	45.4	25.3
Department of Health, Education, and Welfare	5.9	0.4	8.0	2.1	20.4	32.2
Department of the Interior	6.6	2.1	15.3	1.8	7.8	3.6
National Aeronautics and Space Administration	12.9	20.8	8.3	4.7	1.1	1.2
Department of Commerce	4.7	1.8	9.5	3.3	6.7	3.9
Energy Research & Development Administration	2.5	2.7	3.8	0.6	0.1	0.3
Other agencies	6.8	3.7	7.7	6.4	10.2	22.5

NOTE: Excludes uniformed military scientists and engineers and administration of research and development. Percents may not add to 100 because of rounding.
SOURCE: National Science Foundation, based on data of the U.S. Civil Service Commission.

APPENDIXES

A. Basis for Sectoring and Technical Notes

B. Statistical Tables

APPENDIX A

Basis for Sectoring

The National Science Foundation follows a four-sector division in surveying R&D funds and personnel and maintaining the time series for expenditures and employment. This division is based on an approach that attempts to take account of both the legal nature and major functions of organizations active in financing and performing basic research, applied research, and development. Grouping diverse types of organizations into discrete sectors, however, requires certain arbitrary judgments because of the mixed nature of many organizations, particularly those in the university and other nonprofit sectors.

The *Federal sector* is made up of the agencies of the Federal Government. The *industry sector* consists of both manufacturing and nonmanufacturing companies. Manufacturing is classified in major industry groupings; and nonmanufacturing, which includes organizations such as those in selected service industries, is treated as a unit. Federally Funded Research and Development Centers (FFRDC's) administered by industrial firms are also included.

The *universities and colleges sector* is composed of all institutions of higher education, both public and private. The term "universities and colleges" is used in this report to refer to the academic institutions as a group without the associated FFRDC's administered by the schools for various Federal agencies. The universities and colleges comprise the following:

Colleges of liberal arts; schools of arts and sciences; professional schools, such as engineering and medical schools, including affiliated hospitals; associated research institutions, and similar organizations, which are integral parts of the universities and colleges; agricultural experiment stations, and associated schools of agriculture.

Funds used at the universities and attributed to the universities sector as a source consist of several components: (1) State and local government funds separately budgeted for research and development, and (2) unrestricted or general funds which the institutions themselves have been free to allocate for research. Funds from the Federal Government, industry, or other nonprofit institutions, which are supplied in the form of grants or contracts for research or development at a university, are credited to the appropriate source in the performance of research and development by universities and colleges. Thus, research contracts from industry are treated as university performance funded by industry as the source, whereas funds given to the institution by industry for general educational purposes and used by the school, at its discretion, for research, are treated as university performance financed with the university's own funds.

Institutions in the *other nonprofit sector* fall into two general groups: (1) organizations that are primarily granting in nature, namely private philanthropic foundations and voluntary health agencies, and (2) public and private organizations that are involved in performing research and development, comprising separately incorporated nonprofit research institutes, professional societies, academies of science, museums, zoological gardens, botanical gardens, arboretums, nonprofit hospitals, and FFRDC's administered by nonprofit organizations.

In this report, both the university and the other nonprofit sectors contain private and public institutions—the latter are closely associated with State or local governments. A number of organizations in both sectors, as well as in industry, also receive State and local government funds.

Technical Notes

CONCEPTS AND DEFINITIONS

Research and development in this report consists of basic and applied research in the sciences (including medical sciences) and in engineering and activities in development, all defined below. In terms of fields, the natural sciences—life, physical, and engineering—as well as the social and psychological sciences are covered in the Federal, universities, and other nonprofit sectors. Industry coverage is limited, at present, to the natural sciences.

Research, which encompasses both basic and applied, is systematic, intensive study directed toward fuller scientific knowledge of the subject studied.

Basic research. For three of the sectors—Federal Government, universities and colleges, and other nonprofit institutions—the definition of basic research stresses that it is directed toward increases of knowledge in science with "...a fuller knowledge or understanding of the subject under study, rather than a practical application thereof." To take account of an individual industrial company's commercial goals, the definition for the industry sector is modified to indicate that basic research projects represent "...original investigations for the advancement of scientific knowledge...which do not have specific commercial objectives, although they may be in fields of present or potential interest to the reporting company."

Applied research. The following is the core definition in the NSF questionnaire sent to the universities and colleges: "Applied research is directed toward practical application of knowledge." Here again, the definition for the industry survey takes account of the characteristics of industrial organizations it covers "...research projects which represent investigations directed to discovery of new scientific knowledge and which have specific commercial objectives with respect to either products or processes." By this definition, applied research in industry differs from basic research chiefly in terms of objectives of the reporting company.

Development. The NSF survey concept of development may be summarized as "...the systematic use of scientific knowledge directed toward the production of useful materials, devices, systems or methods, including design and development of prototypes and processes."

FUNDS

Current operating costs

Funds used for research and development, reported in this study, refer to current operating costs, consisting of both direct and indirect costs including depreciation, insofar as this information is available to respondents. Capital expenditures are excluded by definition and this is followed by the industry, universities and colleges, and other nonprofit sectors. Under the accounting practices of some Federal agencies—particularly the Department of Defense—data on Federal R&D funds, which are available in detail only in terms of obligations rather than expenditures, do not include an allowance for depreciation but do include some obligations for capital items.

Performer-reporting basis

In the Foundation's surveys, respondents in all four sectors indicate the amounts they spend on research and development in their own sector and the sources of these funds. The National Science Foundation bases all national totals on data as reported by performers because institutions doing research and development are in the best position to: (a) indicate how much they spent in the actual conduct of research and development in a given year, (b) classify their work as basic, applied, etc., and (c) identify the sector of the economy in which their financing originated. The use of performer reporting throughout also reduces the possibility of double counting. Because the national time series on Federal funds spent in research and development are based on expenditures reported by organizations which have actually performed the research and development, they differ from the series in the *Federal Funds for Research, Development, and Other Scientific Activities* on agency obligations for research and development to be performed in the non-Federal sectors. Federal agency obligations are used in the series only for intramural performance in agency laboratories where they are treated as the equivalent of expenditures. Expenses of Federal personnel engaged in planning and administering intramural and extramural R&D programs are also included in the intramural performance total.

There have been surveys in all four sectors thus far in the NSF time series for the following years: 1953-54, 1957-58, 1964, 1966, and 1973. In general, the Federal Government and industry have been surveyed every year, but it has not been possible to maintain the same frequency for the universities and other nonprofit institutions. National data for other years are based on survey data on the performance of total research and development, basic research, applied research, and development from the Federal and industry sectors and on estimates for the university and other nonprofit sectors.

Single-year designation for national totals

Data for calendar year 1953 for industry and nonprofit institutions are combined with Federal intramural and university data for fiscal year 1953 (that is, July 1952 through June 1953) in the R&D funds series. The sector data for the years following 1953 are grouped accordingly and the annual national totals are based on this phasing.

Defense-space classification

Defense expenditures consist of all R&D spending by DOD and a proportion of Energy Research and Development Administration (ERDA) funds (formerly AEC). Space R&D expenditures are those of NASA. The space activities of DOD are included as spending on defense. The space activities of other Federal agencies are not included; it is estimated they account for less than 5 percent of all space R&D spending. This series has been revised to include R&D performance reporting where available.

Revisions of R&D time series since April 1976

Federal Government. Data were revised based on the NSF annual survey of R&D activities by Federal agencies covering fiscal years 1975, 1976 and 1977, and the 1978 Federal Budget, Special Analysis P. Data were revised back to 1963 to reflect changes in NASA reporting for basic research, applied research, and development.

Industry. Data were revised for 1974 on the basis of the annual "shuttle" questionnaire that enables

respondents to revise the figure reported for the preceding year when they report on the current year. Data for 1975 were obtained from the 1975 industrial R&D survey.

Universities and colleges. Data for 1975 were revised based on information obtained in the 1975 survey.

Other nonprofit institutions. Data for 1964-74 were based on the 1964, 1966, 1969, and 1973 surveys. Data were revised back to 1953 to reflect the latest information from the 1973 survey.

Data for 1975 are classified as preliminary because a final report on intramural performance of research and development was available only for the Federal and the universities and colleges sectors. In addition, preliminary data from the 1975 industrial R&D survey were available. Estimates for 1976 and 1977 are extensions of the regular time series, taking into account trends shown in *Federal Funds for Research, Development, and Other Scientific Activities, Fiscal Years 1975, 1976, and 1977*, Vol. XXV[1] as well as other related information.

[1] National Science Foundation, *Federal Funds for Research, Development, and Other Scientific Activities, Fiscal Years 1975, 1976, and 1977*, Vol. XXV (NSF 77-301) (Washington, D.C. 20402, Supt. of Documents, U.S. Government Printing Office, 1976).

MANPOWER

Full-time-equivalent (FTE) number of scientists and engineers

The concept of the FTE provides a common denominator for combining the number of full-time employees with an FTE number of part-time employees to achieve a quantitative measure of manpower input. The minimum standard for inclusion of scientists and engineers was the performance of professional scientific or engineering work in research and development, requiring a bachelor's degree, or its equivalent, in science or engineering. In the industry, university, and other nonprofit sectors, both the manpower and expenditures data for each year were obtained in the same surveys; in the Federal sector, data on expenditures and civilian scientists and engineers were reported in different inquiries, and estimates of military scientists and engineers were obtained separately.

Revisions of R&D time series since April 1976

Data for 1975 were based on surveys of Federal Government personnel as of October 1975, industry as of January 1975 and January 1976, other nonprofit organizations as of October 1974, and universities and colleges as of January 1975 and January 1976 and other related sources. Data for 1976 are estimated except for the universities and colleges sector. Survey results as of January 1976 for this sector are included.

APPENDIX B
Statistical Tables

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Table B–1. Transfers of funds expended annually for performance of research and development by sector, distributed by source, 1953–77[1]

[Dollars in millions]

Year	Total R&D	Federal Government		Industry[2]			Universities and colleges					Associated FFRDC's[3]		Other nonprofit institutions[2]			
			Source		Sources			Sources					Source		Sources		
		Total funds used	Federal Government	Total funds used	Federal Government	Industry[4]	Total funds used	Federal Government	Industry	Universities and colleges[4]	Other nonprofit institutions	Total funds used	Federal Government	Total funds used	Federal Government	Industry	Other nonprofit institutions[4]
1953	5,124	1,010	1,010	3,630	1,430	2,200	255	138	19	72	26	121	121	108	54	26	28
1954	5,644	1,020	1,020	4,070	1,750	2,320	290	160	22	80	28	141	141	123	61	31	31
1955	6,172	905	905	4,640	2,180	2,460	312	169	25	88	30	180	180	135	68	35	32
1956	8,363	1,040	1,040	6,605	3,328	3,277	372	213	29	96	34	194	194	152	77	37	38
1957	9,775	1,220	1,220	7,731	4,335	3,396	410	229	34	109	38	240	240	174	86	37	51
1958	10,711	1,374	1,374	8,389	4,759	3,630	456	254	39	121	42	293	293	199	99	38	62
1959	12,358	1,640	1,640	9,618	5,635	3,983	526	306	39	134	47	338	338	236	127	42	67
1960	13,523	1,726	1,726	10,509	6,081	4,428	646	405	40	149	52	360	360	282	166	48	68
1961	14,316	1,874	1,874	10,908	6,240	4,668	763	500	40	165	58	410	410	361	226	49	86
1962	15,394	2,098	2,098	11,464	6,435	5,029	904	613	40	185	66	470	470	458	295	54	109
1963	17,059	2,279	2,279	12,630	7,270	5,360	1,081	760	41	207	73	530	530	539	365	55	119
1964	18,854	2,838	2,838	13,512	7,720	5,792	1,275	916	41	235	83	629	629	600	433	55	112
1965	20,044	3,093	3,093	14,185	7,740	6,446	1,474	1,073	41	267	93	629	629	663	477	62	124

Table B–1. Transfers of funds expended annually for performance of research and development by sector, distributed by source, 1953–77[1] – Con.

[Dollars in millions]

Year	Total R&D	Federal Government		Industry[2]			Universities and colleges					Associated FFRDC's[3]		Other nonprofit institutions[2]			
			Source		Sources			Sources					Source		Sources		
		Total funds used	Federal Government	Total funds used	Federal Government	Industry[4]	Total funds used	Federal Government	Industry	Universities and colleges[4]	Other nonprofit institutions	Total funds used	Federal Government	Total funds used	Federal Government	Industry	Other nonprofit institutions[4]
1966	21,846	3,220	3,220	15,548	8,332	7,216	1,715	1,262	42	303	108	630	630	733	525	70	138
1967	23,146	3,396	3,396	16,385	8,365	8,020	1,921	1,409	48	345	119	673	673	771	552	74	145
1968	24,604	3,493	3,493	17,429	8,560	8,869	2,149	1,573	55	390	131	719	719	814	582	81	151
1969	25,626	3,503	3,503	18,308	8,451	9,857	2,220	1,595	60	420	145	725	725	870	616	93	161
1970	25,905	3,855	3,855	18,062	7,779	10,283	2,335	1,648	61	461	165	737	737	916	649	95	172
1971	26,595	4,156	4,156	18,311	7,666	10,645	2,500	1,724	70	529	177	716	716	912	630	98	184
1972	28,257	4,482	4,482	19,383	8,057	11,326	2,676	1,839	75	575	187	764	764	952	653	101	198
1973	30,303	4,619	4,619	20,921	8,225	12,696	2,940	2,038	85	615	202	817	817	1,006	690	105	211
1974	32,260	4,815	4,815	22,399	8,340	14,059	3,017	2,032	96	671	218	865	865	1,164	822	111	231
1975	34,558	5,395	5,395	23,540	8,765	14,775	3,393	2,285	112	741	255	987	987	1,243	875	115	253
1976 (est.)	37,363	5,800	5,800	25,500	9,500	16,000	3,660	2,450	123	808	279	1,080	1,080	1,323	925	120	278
1977 (est.)	40,800	6,500	6,500	27,750	10,500	17,250	3,956	2,634	134	883	305	1,177	1,177	1,417	987	124	306

[1] All data are based on reports by performers.

[2] Expenditures for Federally Funded Research and Development Centers administered by both industry and by nonprofit institutions are included in the totals of the respective sectors.

[3] FFRDC's administered by individual universities and colleges and by university consortia.

[4] Includes State and local government funds.

Table B–2. Transfers of funds expended annually for performance of basic research by sector, distributed by source, 1953–77[1]

[Dollars in millions]

Year	Total basic research	Federal Government		Industry[2]			Universities and colleges					Associated FFRDC's[3]		Other nonprofit institutions[2]			
			Source		Sources			Sources					Source		Sources		
		Total funds used	Federal Government	Total funds used	Federal Government	Industry[4]	Total funds used	Federal Government	Industry	Universities and colleges[4]	Other nonprofit institutions	Total funds used	Federal Government	Total funds used	Federal Government	Industry	Other nonprofit institutions[4]
1953	441	101	101	151	19	132	110	73	12	10	15	33	33	46	25	9	12
1954	496	102	102	166	23	143	136	90	14	15	17	39	39	53	29	11	13
1955	547	90	90	189	27	162	159	103	16	21	19	49	49	60	33	13	14
1956	679	104	104	253	37	216	200	130	18	30	22	51	51	71	39	15	17
1957	780	122	122	271	41	230	240	155	21	39	25	65	65	82	44	15	23
1958	877	126	126	295	43	252	281	178	24	50	29	78	78	97	53	16	28
1959	1,040	173	173	320	72	248	343	226	24	60	33	92	92	112	64	18	30
1960	1,197	160	160	376	79	297	433	299	24	72	38	97	97	131	80	21	30
1961	1,401	206	206	395	81	314	536	382	25	85	44	115	115	149	90	22	37
1962	1,724	251	251	488	143	345	659	481	25	102	51	136	136	190	120	24	46
1963	1,965	255	255	522	147	375	814	610	25	121	58	159	159	215	140	25	50
1964	2,289	314	314	549	165	384	1,003	767	25	144	67	191	191	232	160	25	47
1965	2,555	364	364	592	186	406	1,138	879	26	164	69	208	208	253	172	29	52

Table B–2. Transfers of funds expended annually for performance of basic research by sector, distributed by source, 1953–77[1] – Con.

[Dollars in millions]

Year	Total basic research	Federal Government		Industry[2]			Universities and colleges					Associated FFRDC's[3]		Other nonprofit institutions[2]			
			Source		Sources			Sources					Source		Sources		
		Total funds used	Federal Government	Total funds used	Federal Government	Industry[4]	Total funds used	Federal Government	Industry	Universities and colleges[4]	Other nonprofit institutions	Total funds used	Federal Government	Total funds used	Federal Government	Industry	Other nonprofit institutions[4]
1966	2,814	385	385	624	173	451	1,303	1,009	27	196	71	227	227	275	185	32	58
1967	3,039	418	418	629	202	427	1,457	1,124	31	223	79	250	250	285	190	34	61
1968	3,315	451	451	642	180	462	1,649	1,251	36	276	86	276	276	297	197	37	63
1969	3,421	516	516	618	160	458	1,707	1,275	39	298	95	275	275	305	195	43	67
1970	3,572	600	600	602	158	444	1,796	1,296	40	350	110	269	269	305	189	44	72
1971	3,568	491	491	581	125	456	1,914	1,349	46	400	119	260	260	322	200	45	77
1972	3,757	561	561	579	127	452	2,022	1,421	53	414	134	250	250	345	214	47	84
1973	3,858	537	537	612	127	485	2,055	1,456	57	408	134	297	297	357	218	49	90
1974	4,105	585	585	677	159	518	2,147	1,522	61	426	138	300	300	396	245	52	99
1975	4,455	645	645	702	154	548	2,394	1,691	71	470	162	307	307	407	245	54	108
1976 (est.)	4,779	680	680	740	160	580	2,584	1,813	78	515	178	336	336	439	265	56	118
1977 (est.)	5,178	750	750	790	175	615	2,793	1,949	85	564	195	366	366	479	290	58	131

[1] All data are based on reports by performers.

[2] Expenditures for Federally Funded Research and Development Centers administered by both industry and by nonprofit institutions are included in the totals of the respective sectors.

[3] FFRDC's administered by individual universities and colleges and by university consortia.

[4] Includes State and local government funds.

Table B–3. Transfers of funds expended annually for performance of applied research by sector, distributed by source: 1953–77[1]

[Dollars in millions]

Year	Total applied research	Federal Government		Industry[2]			Universities and colleges					Associated FFRDC's[3]		Other nonprofit institutions[3]			
		Total funds used	Source	Total funds used	Sources		Total funds used	Sources				Total funds used	Source	Total funds used	Sources		
			Federal Government		Federal Government	Industry[4]		Federal Government	Industry	Universities and colleges[4]	Other nonprofit institutions		Federal Government		Federal Government	Industry	Other nonprofit institutions[4]
1953	1,279	345	345	726	288	438	130	57	6	57	10	44	44	34	13	11	10
1954	1,390	349	349	814	322	492	137	61	7	59	10	51	51	39	15	13	11
1955	1,481	310	310	928	368	560	136	58	8	60	10	65	65	42	17	14	11
1956	1,889	356	356	1,268	474	794	147	68	9	59	11	71	71	47	19	14	14
1957	2,374	417	417	1,670	678	992	145	62	11	61	11	86	86	56	22	14	20
1958	2,699	474	474	1,911	774	1,137	148	64	12	61	11	102	102	64	25	14	25
1959	2,900	558	558	1,991	813	1,178	155	67	12	64	12	119	119	77	35	15	27
1960	3,020	595	595	2,029	833	1,196	179	88	13	66	12	122	122	95	50	17	28
1961	3,065	634	634	1,977	812	1,165	192	98	13	69	12	135	135	127	75	17	35
1962	3,665	702	702	2,449	1,011	1,438	205	109	13	70	13	155	155	154	90	19	45
1963	3,742	715	715	2,457	1,007	1,450	227	128	14	72	13	170	170	173	105	19	49
1964	4,128	903	903	2,600	1,040	1,560	232	127	14	77	14	202	202	191	125	19	47
1965	4,339	990	990	2,658	1,038	1,620	279	157	13	88	21	204	204	208	135	21	52

Table B–3. Transfers of funds expended annually for performance of applied research by sector, distributed by source: 1953–77[1] – Con.

[Dollars in millions]

Year	Total applied research	Federal Government		Industry[2]			Universities and colleges					Associated FFRDC's[3]		Other nonprofit institutions[2]			
			Source		Sources			Sources					Source		Sources		
		Total funds used	Federal Government	Total funds used	Federal Government	Industry[4]	Total funds used	Federal Government	Industry	Universities and colleges[4]	Other nonprofit institutions	Total funds used	Federal Government	Total funds used	Federal Government	Industry	Other nonprofit institutions[4]
1966	4,601	997	997	2,843	1,039	1,804	328	194	13	89	32	207	207	226	145	24	57
1967	4,803	1,050	1,050	2,915	1,066	1,849	374	222	15	102	35	219	219	245	160	25	60
1968	5,171	1,150	1,150	3,124	1,043	2,081	404	254	16	97	37	231	231	262	172	28	62
1969	5,341	1,140	1,140	3,287	1,015	2,272	406	245	16	105	40	210	210	298	200	32	66
1970	5,705	1,313	1,313	3,426	1,049	2,377	427	268	16	98	45	216	216	323	220	33	70
1971	5,843	1,408	1,408	3,413	974	2,439	474	292	19	115	48	210	210	338	230	34	74
1972	6,027	1,421	1,421	3,471	941	2,530	544	338	19	141	46	226	226	365	251	35	79
1973	6,594	1,559	1,559	3,739	975	2,764	717	462	24	174	57	226	226	353	234	36	83
1974	7,197	1,625	1,625	4,160	1,074	3,086	737	439	29	203	66	267	267	408	280	38	90
1975	7,816	1,768	1,768	4,411	1,167	3,244	851	516	34	224	77	347	347	439	300	39	100
1976 (est.)	8,301	1,850	1,850	4,675	1,225	3,450	915	554	37	241	83	380	380	481	330	41	110
1977 (est.)	9,010	2,050	2,050	5,050	1,350	3,700	989	595	40	263	91	414	414	507	345	42	120

[1] All data are based on reports by performers.

[2] Expenditures for Federally Funded Research and Development Centers administered by both industry and by nonprofit institutions are included in the totals of the respective sectors.

[3] FFRDC's administered by individual universities and colleges and by university consortia.

[4] Includes State and local government funds.

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Table B–4. Transfers of funds expended annually for performance of development by sector, distributed by source: 1953–77[1]

[Dollars in millions]

Year	Total development	Federal Government		Industry[2]			Universities and colleges					Associated FFRDC's[3]		Other nonprofit institutions[2]			
			Source		Sources			Sources					Source		Sources		
		Total funds used	Federal Government	Total funds used	Federal Government	Industry[4]	Total funds used	Federal Government	Industry	Universities and colleges[4]	Other nonprofit institutions	Total funds used	Federal Government	Total funds used	Federal Government	Industry	Other nonprofit institutions[4]
1953	3,404	564	564	2,753	1,123	1,630	15	8	1	5	1	44	44	28	16	6	6
1954	3,758	569	569	3,090	1,405	1,685	17	9	1	6	1	51	51	31	17	7	7
1955	4,144	505	505	3,523	1,785	1,738	17	8	1	7	1	66	66	33	18	8	7
1956	5,795	580	580	5,084	2,817	2,267	25	15	2	7	1	72	72	34	19	8	7
1957	6,621	681	681	5,790	3,616	2,174	25	12	2	9	2	89	89	36	20	8	8
1958	7,135	774	774	6,183	3,942	2,241	27	12	3	10	2	113	113	38	21	8	9
1959	8,418	909	909	7,307	4,750	2,557	28	13	3	10	2	127	127	47	28	9	10
1960	9,306	971	971	8,104	5,169	2,935	34	18	3	11	2	141	141	56	36	10	10
1961	9,850	1,034	1,034	8,536	5,347	3,189	35	20	2	11	2	160	160	85	61	10	14
1962	10,005	1,145	1,145	8,527	5,281	3,246	40	23	2	13	2	179	179	114	85	11	18
1963	11,352	1,309	1,309	9,651	6,116	3,535	40	22	2	14	2	201	201	151	120	11	20
1364	12,437	1,621	1,621	10,363	6,515	3,848	40	22	2	14	2	236	236	177	148	11	18
1965	13,150	1,739	1,739	10,935	6,516	4,419	57	37	2	15	3	217	217	202	170	12	20

Table B–4. Transfers of funds expended annually for performance of development by sector, distributed by source: 1953–77[1] – Con.

[Dollars in millions]

Year	Total development	Federal Government		Industry[2]			Universities and colleges					Associated FFRDC's[3]		Other nonprofit institutions[2]			
		Total funds used	Source	Total funds used	Sources		Total funds used	Sources				Total funds used	Source	Total funds used	Sources		
			Federal Government		Federal Government	Industry[4]		Federal Government	Industry	Universities and colleges[4]	Other nonprofit institutions		Federal Government		Federal Government	Industry	Other nonprofit institutions[4]
1966	14,431	1,838	1,838	12,081	7,120	4,961	84	59	2	18	5	196	196	232	195	14	23
1967	15,304	1,928	1,928	12,841	7,097	5,744	90	63	2	20	5	204	204	241	202	15	24
1968	16,118	1,892	1,892	13,663	7,337	6,326	96	68	3	17	8	212	212	255	213	16	26
1969	16,864	1,847	1,847	14,403	7,276	7,127	107	75	5	17	10	240	240	267	221	18	28
1970	16,628	1,942	1,942	14,034	6,572	7,462	112	84	5	13	10	252	252	288	240	18	30
1971	17,184	2,257	2,257	14,317	6,567	7,750	112	83	5	14	10	246	246	252	200	19	33
1972	18,473	2,500	2,500	15,333	6,979	8,354	110	80	3	20	7	288	288	242	188	19	35
1973	19,851	2,523	2,523	16,570	7,123	9,447	168	120	4	33	11	294	294	296	238	20	38
1974	20,958	2,605	2,605	17,562	7,107	10,455	133	71	6	42	14	298	298	360	297	21	42
1975	22,287	2,982	2,982	18,427	7,444	10,983	148	78	7	47	16	333	333	397	330	22	45
1976 (est.)	24,283	3,270	3,270	20,085	8,115	11,970	161	83	8	52	18	364	364	403	330	23	50
1977 (est.)	26,612	3,700	3,700	21,910	8,975	12,935	174	90	9	56	19	397	397	431	352	24	55

[1] Data are based on reports by performers.

[2] Expenditures for Federally Funded Research and Development Centers administered by both industry and by nonprofit institutions are included in the totals of the respective sectors.

[3] FFRDC's administered by individual universities and colleges and by university consortia.

[4] Includes State and local government funds.

Table B–5. Sources of funds used for research and development, by sector: 1953-77[1]

[Dollars in millions]

Year	Current dollars					Constant 1972 dollars[2]				
	Total	Federal Government	Industry	Universities and colleges	Other nonprofit institutions	Total	Federal Government	Industry	Universities and colleges	Other nonprofit institutions
1953	5,124	2,753	2,245	72	54	8,704	4,675	3,813	122	92
1954	5,644	3,132	2,373	80	59	9,456	5,247	3,976	134	99
1955	6,172	3,502	2,520	88	62	10,121	5,743	4,132	144	102
1956	8,363	4,852	3,343	96	72	13,296	7,714	5,315	153	114
1957	9,775	6,110	3,467	109	89	15,034	9,397	5,332	168	137
1958	10,711	6,779	3,707	121	104	16,214	10,262	5,612	183	157
1959	12,358	8,046	4,064	134	114	18,303	11,917	6,019	198	169
1960	13,523	8,738	4,516	149	120	19,693	12,725	6,576	217	175
1961	14,316	9,250	4,757	165	144	20,664	13,351	6,866	238	209
1962	15,394	9,911	5,123	185	175	21,820	14,048	7,262	262	248
1963	17,059	11,204	5,456	207	192	23,829	15,651	7,621	289	268
1964	18,854	12,536	5,888	235	195	25,930	17,241	8,098	323	268
1965	20,044	13,012	6,548	267	217	26,970	17,508	8,811	359	292
1966	21,846	13,969	7,328	303	246	28,460	18,198	9,547	395	320
1967	23,146	14,395	8,142	345	264	29,291	18,217	10,303	437	334
1968	24,604	14,926	9,005	391	282	29,798	18,077	10,906	474	341
1969	25,626	14,896	10,010	420	306	29,550	17,170	11,543	484	353
1970	25,905	14,668	10,439	461	337	28,355	16,055	11,426	505	369
1971	26,595	14,892	10,813	529	361	27,697	15,509	11,261	551	376
1972	28,257	15,795	11,502	575	385	28,257	15,795	11,502	575	385
1973	30,303	16,389	12,886	615	413	28,642	15,491	12,180	581	390
1974	32,260	16,874	14,266	671	449	27,712	14,495	12,255	576	386
1975	34,558	18,307	15,002	741	508	27,158	14,387	11,790	582	399
1976 (est.)	37,363	19,755	16,243	808	557	27,927	14,766	12,111	604	446
1977 (est.)	40,800	21,798	17,508	883	611	28,879	15,429	12,393	625	432

[1] Summary of R&D data in table B-1, by source.
[2] Based on GNP implicit price deflator.
SOURCE: National Science Foundation

Table B–6. Sources of funds used for basic research, by sector: 1953-77[1]

[Dollars in millions]

Year	Current dollars					Constant 1972 dollars[2]				
	Total	Federal Government	Industry	Universities and colleges	Other nonprofit institutions	Total	Federal Government	Industry	Universities and colleges	Other nonprofit institutions
1953	441	251	153	10	27	749	426	260	17	46
1954	496	283	168	15	30	831	474	282	25	50
1955	547	302	191	21	33	897	496	313	34	54
1956	679	361	249	30	39	1,080	574	396	48	62
1957	780	427	266	39	48	1,200	657	409	60	74
1958	877	478	292	50	57	1,328	724	442	76	86
1959	1,040	627	290	60	63	1,540	929	429	89	93
1960	1,197	715	342	72	68	1,743	1,041	498	105	99
1961	1,401	874	361	85	81	2,022	1,261	521	123	117
1962	1,724	1,131	394	102	97	2,444	1,603	559	145	137
1963	1,965	1,311	425	121	108	2,745	1,831	594	169	151
1964	2,289	1,597	434	144	114	3,148	2,196	597	198	157
1965	2,555	1,809	461	164	121	3,438	2,434	620	221	163
1966	2,814	1,979	510	196	129	3,666	2,578	665	255	168
1967	3,039	2,184	492	223	140	3,846	2,764	623	282	177
1968	3,315	2,355	535	276	149	4,015	2,852	648	334	181
1969	3,421	2,421	540	298	162	3,945	2,792	622	344	187
1970	3,572	2,512	528	350	182	3,910	2,750	578	383	199
1971	3,568	2,425	547	400	196	3,716	2,525	570	417	204
1972	3,757	2,573	552	414	218	3,757	2,573	552	414	218
1973	3,858	2,635	591	408	224	3,647	2,490	559	386	212
1974	4,105	2,811	631	426	237	3,526	2,415	542	366	203
1975	4,455	3,042	673	470	270	3,501	2,391	529	369	212
1976 (est.)	4,779	3,254	714	515	296	3,572	2,432	534	385	221
1977 (est.)	5,178	3,530	758	564	326	3,665	2,499	536	399	231

[1] Summary of basic research data in table B-2, by source.

[2] Based on GNP implicit price deflator.

SOURCE: National Science Foundation

Table B–7. Sources of funds used for applied research, by sector: 1953-77[1]

[Dollars in millions]

Year	Current dollars					Constant 1972 dollars[2]				
	Total	Federal Government	Industry	Universities and colleges	Other nonprofit institutions	Total	Federal Government	Industry	Universities and colleges	Other nonprofit institutions
1953	1,279	747	455	57	20	2,172	1,268	773	97	34
1954	1,390	798	512	59	21	2,329	1,337	858	99	35
1955	1,481	818	582	60	21	2,429	1,342	955	98	34
1956	1,889	988	817	59	25	3,003	1,570	1,299	94	40
1957	2,374	1,265	1,017	61	31	3,651	1,945	1,564	94	48
1958	2,699	1,439	1,163	61	36	4,086	2,178	1,761	92	55
1959	2,900	1,592	1,205	64	39	4,295	2,358	1,784	95	58
1960	3,020	1,688	1,226	66	40	4,398	2,458	1,786	96	58
1961	3,065	1,754	1,195	69	47	4,424	2,531	1,725	100	68
1962	3,665	2,067	1,470	70	58	5,195	2,930	2,084	99	82
1963	3,742	2,125	1,483	72	62	5,227	2,968	2,071	101	87
1964	4,128	2,397	1,593	77	61	5,677	3,296	2,191	106	84
1965	4,339	2,524	1,654	88	73	5,838	3,396	2,226	118	98
1966	4,601	2,582	1,841	89	89	5,994	3,364	2,398	116	116
1967	4,803	2,717	1,889	102	95	6,078	3,438	2,391	129	120
1968	5,171	2,850	2,125	97	99	6,263	3,452	2,574	117	120
1969	5,341	2,810	2,320	105	106	6,159	3,241	2,675	121	122
1970	5,705	3,066	2,426	98	115	6,244	3,356	2,655	107	126
1971	5,843	3,114	2,492	115	122	6,085	3,243	2,595	120	127
1972	6,027	3,177	2,584	141	125	6,027	3,177	2,584	141	125
1973	6,594	3,456	2,824	174	140	6,232	3,267	2,669	164	132
1974	7,197	3,685	3,153	203	156	6,182	3,165	2,709	174	134
1975	7,816	4,098	3,317	224	177	6,142	3,220	2,607	176	139
1976 (est.)	8,301	4,339	3,528	241	193	6,204	3,243	2,637	180	144
1977 (est.)	9,010	4,754	3,782	263	211	6,377	3,362	2,677	186	149

[1] Summary of applied research data in table B-3, by source.

[2] Based on GNP implicit price deflator.

SOURCE: National Science Foundation

Table B–8. Sources of funds used for development, by sector: 1953-77[1]

[Dollars in millions]

Year	Current dollars					Constant 1972 dollars[2]				
	Total	Federal Government	Industry	Universities and colleges	Other nonprofit institutions	Total	Federal Government	Industry	Universities and colleges	Other nonprofit institutions
1953	3,404	1,755	1,637	5	7	5,781	2,981	2,780	8	12
1954	3,758	2,051	1,693	6	8	6,296	3,436	2,836	10	14
1955	4,144	2,382	1,747	7	8	6,796	3,907	2,865	11	13
1956	5,795	3,503	2,277	7	8	9,213	5,569	3,620	11	13
1957	6,621	4,418	2,184	9	10	10,183	6,795	3,359	14	15
1958	7,135	4,862	2,252	10	11	10,801	7,360	3,409	15	17
1959	8,418	5,827	2,569	10	12	12,468	8,630	3,805	15	18
1960	9,306	6,335	2,948	11	12	13,552	9,226	4,293	16	17
1961	9,850	6,622	3,201	11	16	14,218	9,558	4,621	16	23
1962	10,005	6,713	3,259	13	20	14,181	9,515	4,619	18	29
1963	11,352	7,768	3,548	14	22	15,857	10,850	4,956	20	31
1964	12,437	8,542	3,861	14	20	17,105	11,748	5,310	19	28
1965	13,150	8,679	4,433	15	23	17,694	11,678	5,965	20	31
1966	14,431	9,408	4,977	18	28	18,800	12,256	6,484	23	37
1967	15,304	9,494	5,761	20	29	19,367	12,015	7,290	25	37
1968	16,118	9,722	6,345	17	34	19,520	11,774	7,684	21	41
1969	16,864	9,659	7,150	17	38	19,447	11,138	8,245	20	44
1970	16,628	9,090	7,485	13	40	18,201	9,950	8,193	14	44
1971	17,184	9,353	7,774	14	43	17,896	9,740	8,096	15	45
1972	18,473	10,035	8,376	20	42	18,473	10,035	8,376	20	42
1973	19,851	10,298	9,471	33	49	18,763	9,734	8,952	31	46
1974	20,958	10,378	10,482	42	56	18,004	8,915	9,005	36	48
1975	22,287	11,167	11,012	47	61	17,514	8,775	8,654	37	48
1976 (est.)	24,283	12,162	12,001	52	68	18,150	9,090	8,970	39	51
1977 (est.)	26,612	13,514	12,968	56	74	18,836	9,565	9,179	40	52

[1] Summary of development data in table B-4, by source.

[2] Based on GNP implicit price deflator.

SOURCE: National Science Foundation

Table B–9. Trends in Federal and non-Federal R&D outlays: 1953-77

[Percents]

Year	Federal				Non-Federal
	Total	Defense related	Space related	Civilian related	
1953	54	48	1	5	46
1954	56	49	1	6	44
1955	57	48	1	8	43
1956	58	49	1	8	42
1957	62	53	1	9	38
1958	63	53	1	10	37
1959	65	54	3	8	35
1960	65	52	3	9	35
1961	65	50	6	9	35
1962	64	48	7	10	36
1963	66	41	14	10	34
1964	66	37	19	11	34
1965	65	33	21	11	35
1966	64	32	19	12	36
1967	62	35	14	13	38
1968	61	34	13	13	39
1969	58	34	11	13	42
1970	57	33	10	14	43
1971	56	32	9	15	44
1972	56	33	8	15	44
1973	54	32	7	15	46
1974	52	29	7	16	48
1975	53	27	8	18	47
1976 (est.)	53	26	8	18	47
1977 (est.)	53	27	8	18	47

NOTE: Detail may not add to 100 because of rounding.
SOURCE: National Science Foundation

Table B–10. Full-time-equivalent (FTE) scientists and engineers employed in research and development, by sector: selected years[1]

[In thousands]

Sector	1954	1958	1961	1965	1969	1970	1971	1972	1973	1974	1975[2]	1976[2]
Total	237.1	354.1	425.7	494.5	556.6	546.5	526.4	518.5	520.4	524.9	533.7	541.9
Federal Government[3]	37.7	46.0	51.1	61.8	69.9	69.8	66.5	65.2	62.3	65.0	64.5	65.3
Industry[4, 5]	164.1	256.1	312.0	348.4	385.6	375.5	358.4	353.3	360.6	359.3	361.5	364.4
Universities and colleges, total	25.0	36.5	42.4	53.4	68.3	68.5	68.4	66.5	63.5	65.5	70.2	72.4
Scientists and engineers	20.3	29.2	33.6	40.4	50.4	50.3	49.8	48.9	46.9	48.0	51.6	53.5
Graduate students[6]	4.7	7.3	8.8	13.0	17.9	18.2	18.6	17.6	16.6	17.5	18.6	18.9
University associated FFRDC's, total	5.0	8.1	9.1	11.1	11.6	11.5	11.5	11.7	12.0	12.1	12.7	13.4
Scientists and engineers	4.9	7.9	8.8	10.7	11.1	11.0	11.0	11.3	11.7	11.8	12.3	13.0
Graduate students[6]	.1	.2	.3	.4	.5	.5	.5	.4	.3	.3	.4	.4
Other nonprofit institutions[4]	5.3	7.4	11.1	19.8	21.2	21.2	21.6	21.8	22.0	23.0	24.8	26.4

[1] Number of full-time employees plus the FTE of part-time employees. Excludes scientists and engineers employed in State and local government agencies.

[2] Estimate.

[3] Includes both civilian and military service personnel and managers of R&D. Military R&D scientists and engineers in the Department of Defense were estimated at 7,000 in 1954, 8,400 in 1958, 9,200 in 1961, 12,000 in 1965, 14,000 in 1969 and 1970, 12,000 in 1971, 10,700 in 1972, 8,100 in 1973, 7,600 in 1974, 7,700 in 1975 and 7,400 in 1976.

[4] Includes professional R&D personnel employed at FFRDC's administered by organizations in the sector.

[5] Excludes social scientists.

[6] Numbers of FTE graduate students receiving stipends and engaged in R&D.

NOTE: The figures for the industry sector represent yearly averages and may differ from other data in the text which is based upon surveys reporting the employment in a single month of the year.

SOURCE: National Science Foundation

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HIGHLIGHTS

"R&D Spending Reaches Nearly $41 Billion in 1977"	77-306	——
"Graduate Science and Engineering Enrollment Up Only 1 Percent in 1976"	77-302	——
"Energy Increase of 18 Percent Paces Industrial R&D Spending in 1975"	76-324	——